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Radio for Everybody pages { 8–9, 12–13, 20, 23, 68–69

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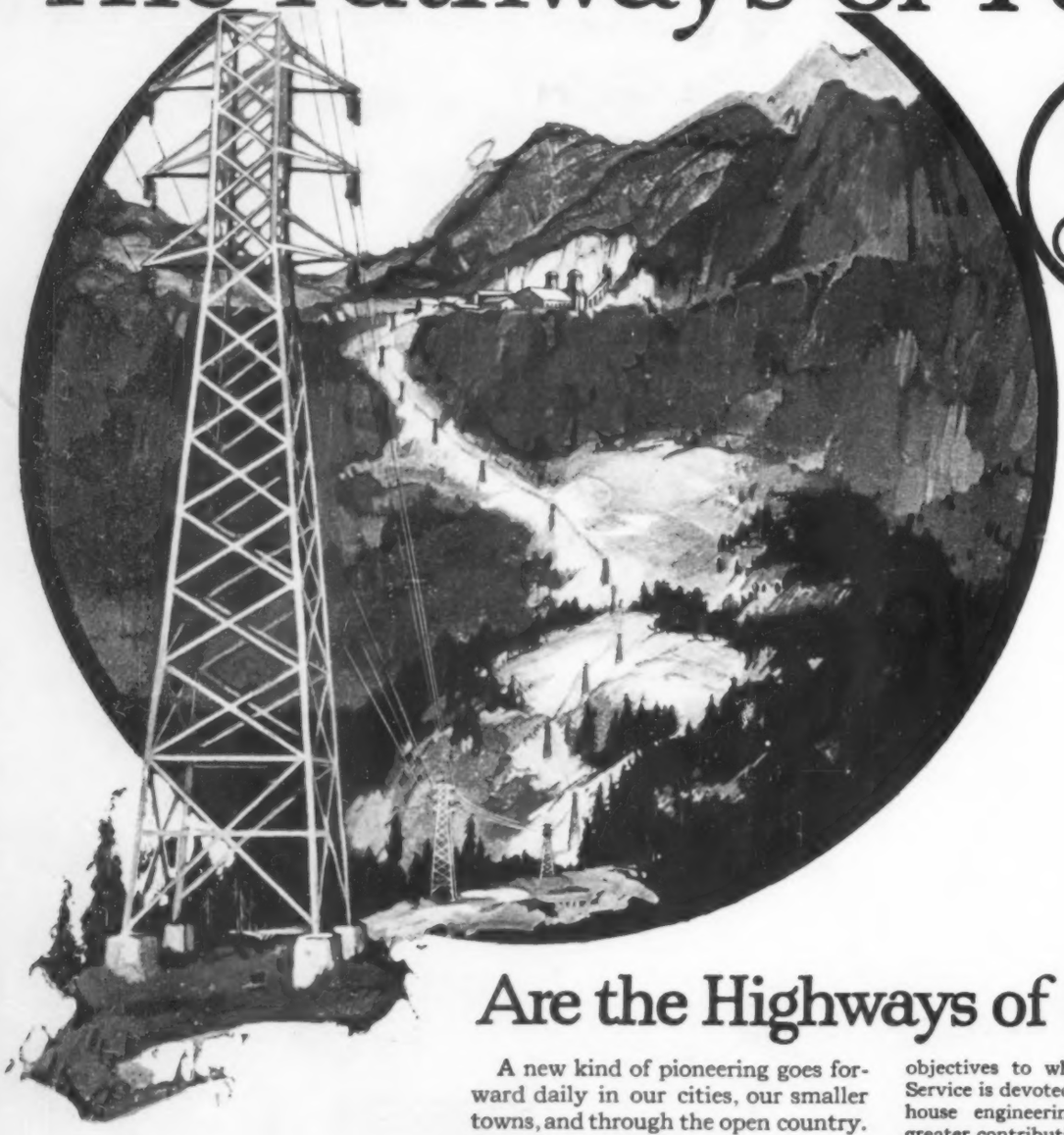
LOCATING AN UNLICENSED AND UNLAWFUL RADIO TRANSMITTER WITH THE RADIO COMPASS.—[See page 72]

Scientific American Publishing Co., Munn & Co., New York

The Pathways of Power—



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With the Editors

WITH this issue we start a new volume, No. 127, of the unbroken SCIENTIFIC AMERICAN lineage. As a weekly publication, appearing every Saturday, we had two volumes per year, each containing twenty-five, twenty-six, and even twenty-seven issues, as the case might be. In our present monthly form we have two volumes per year, with six issues to the volume. Just how many complete sets of SCIENTIFIC AMERICAN bound and unbound volumes are in existence, we cannot venture to guess. Such sets must be very scarce, although sets dating back ten, twenty, thirty, forty and even fifty years are relatively numerous, since many of our life-long readers habitually preserve their copies after reading them through. Not so long ago we were commissioned by a well-known New Yorker to assemble a complete set of SCIENTIFIC AMERICAN volumes. This involved considerable rummaging, inside and outside, until we finally had all but the first volume. Then, through further unrelenting search, we succeeded in obtaining one of the first volumes in fair condition, at a cost of $100, thus completing the set. However, we have here in our editorial rooms a complete set of bound volumes, which are always at your disposal.

IN keeping with our policy of always maintaining a fair and impartial attitude in dealing with controversial subjects where it is difficult to determine which is right and which is wrong, we take up in this issue the fraudulent side of psychical research. That there is much fraud in psychic manifestations, we will all agree; indeed, it is safe to assume that nine-tenths of these manifestations are crude charlatanism. Therefore, a goodly part of our discussion on the psychic must necessarily revolve about the psychic fakes and fakers. To this end we recently invited Dr. Walter Franklin Prince, Principal Research Officer, American Society for Psychical Research, to write for us regarding his work in baring psychic frauds. After considerable persuasion—and we know how to persuade when in quest of authorities such as Dr. Prince—we finally obtained a most interesting manuscript from this well-known psychic investigator. Under the title of "The Psychic Detective," Dr. Prince tells you, in this issue, of his varied experiences in running down fraudulent psychic manifestations. Incidentally, we might add that another investigator is now preparing for us a startling yet strictly authenticated account of the making of spirit photographs. He will tell how certain psychic workers make these photographs by simple photographic tricks; and he even goes so far as to challenge all psychic or spirit photographers to prove their methods to be beyond the reach of the simple tricks which he discloses.

FREQUENTLY we receive a letter from a reader, stating that a certain article, describing a new device, is quite interesting but we overlooked the mention of the name and address of the manufacturer. We therefore take this opportunity of telling you our views in regard to such matters. Lest we be accused of publishing "write-ups" in our text columns, we cannot under any circumstances mention the name and address of the manufacturer of a given device. We do not hesitate to mention the name of the inventor, for that is nothing but fair and does not carry a commercial tinge; but the manufacturer's name and address must be omitted. In our files we have further information concerning the inventions and devices and machinery and materials described in our columns. It is at your disposal at all times; if you are interested in any particular item that appears in any one of our issues, just drop us a line and we will send you the name and address of the manufacturer.

HAVE you heard our radio-phone broadcasting talks? We have been speaking once a week at the WJZ radio-phone station, located at Newark, N. J., with a range of several hundred miles. The same talks are being broadcasted by WWJ in Detroit, Mich., and several other stations, a list of which will be included in our next issue, after we have concluded our arrangements. Several weeks ago our broadcasted talk from WJZ was intercepted by a Lackawanna train leaving the Hoboken terminal, and, by means of a loud-speaker, was heard throughout the railroad coach. By chance we have an article in this issue on the interesting experiments of the Lackawanna Railroad with radio telephony aboard trains. Back in 1913, when the same road was experimenting with radio telegraphy and telephony, the SCIENTIFIC AMERICAN carried several accounts of those pioneer efforts. It makes interesting reading to go back over those 1913 experiments and note how crude the radio telephone was at that time, and then to turn to the account of today's success and tomorrow's promise.

TO map 43 per cent of the United States, the topographic engineers are estimated to have tramped an aggregate of approximately 9,000,000 miles; for the average amount of walking varies from 5 miles for every square mile surveyed in ordinary country, to 10 or more miles in rough country. So writes Guy Elliott Mitchell of the U. S. Geological Survey, in his article, "The Strenuous U. S. Geological Survey," which tells of the fun and the hardships of mapping this great country of ours, together with real scientific points which we have always wanted to know regarding the making of maps. His is a story that combines entertaining reading with sound facts, thrilling experiences with the routine work of the map table, the shooting of black bears in Alaska with the humdrum mapping of city streets. The article is accompanied by numerous interesting photographs. The first instalment—for the article is too long for publication in a single issue and certainly too interesting to be cut by a single line—will appear in an early issue.

OUR August issue promises to be a most interesting one, with plenty of variety, ranging from several radio articles dealing with radio legislature and special equipment for use in the summer camp and in the home, to the fakes of the psychic; from garbage disposal of the latest kind to the proposed 1100-mile system of train ferriage on the Mississippi; from an account of the development of accurate ammunition, by Captain Edward C. Crossman who has written so many illuminating and highly entertaining articles on rifles and ammunition in past issues of the SCIENTIFIC AMERICAN, to a description of the fire detection system for the ocean greyhounds. And having made this statement and written this last piece of "copy" for the July issue, we must turn our efforts to its successor.

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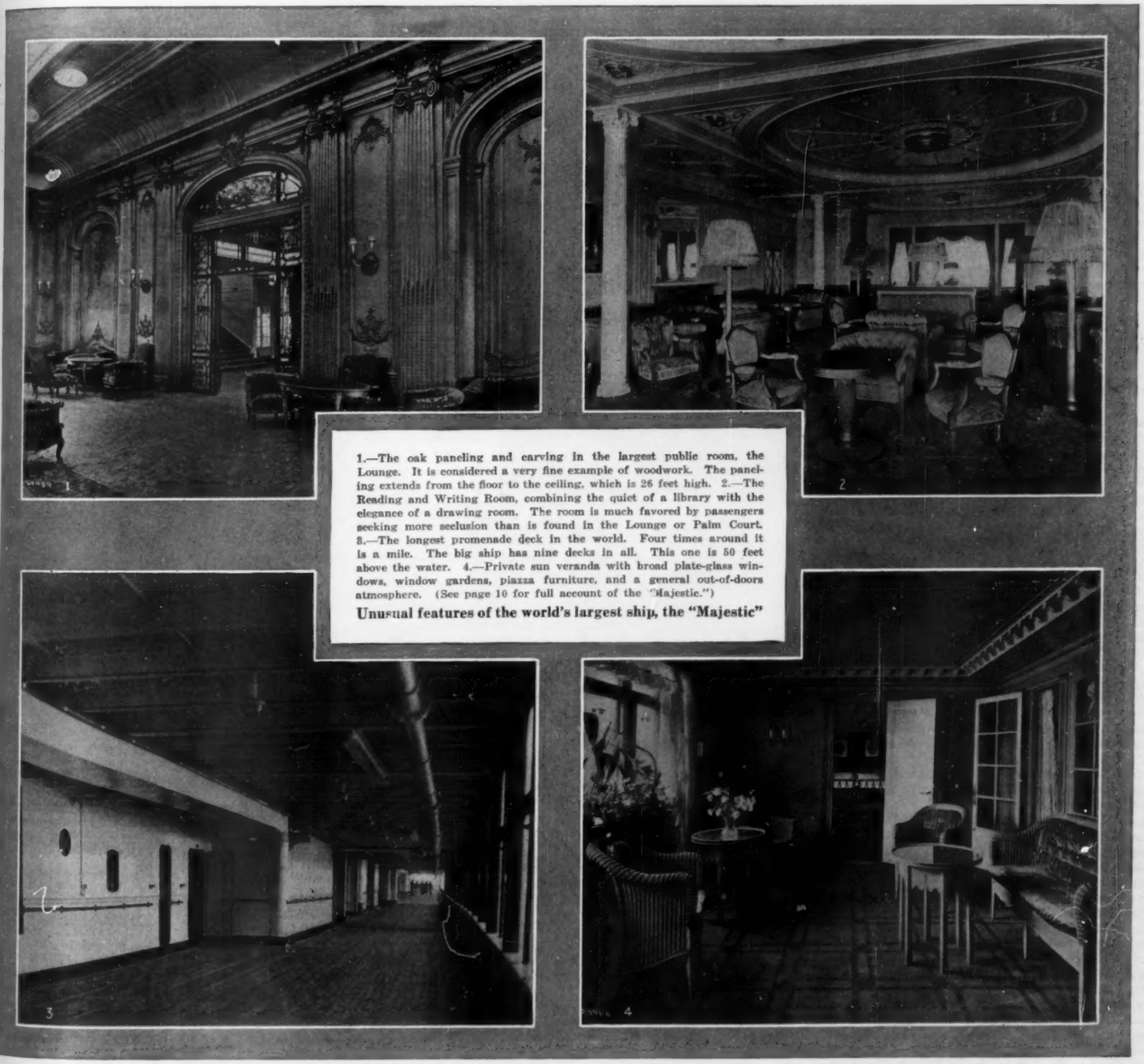
SEVENTY-EIGHTH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, JULY, 1922



1.—The oak paneling and carving in the largest public room, the Lounge. It is considered a very fine example of woodwork. The paneling extends from the floor to the ceiling, which is 26 feet high. 2.—The Reading and Writing Room, combining the quiet of a library with the elegance of a drawing room. The room is much favored by passengers seeking more seclusion than is found in the Lounge or Palm Court. 3.—The longest promenade deck in the world. Four times around it is a mile. The big ship has nine decks in all. This one is 50 feet above the water. 4.—Private sun veranda with broad plate-glass windows, window gardens, piazza furniture, and a general out-of-doors atmosphere. (See page 10 for full account of the "Majestic.")

Unusual features of the world's largest ship, the "Majestic"

GLIMPSES ABOARD THE "MAJESTIC"—LATEST AND LARGEST OF SHIPS

The Psychic Detective

Some of the Pitfalls in the Path of the Psychic Investigator, and How He Avoids Them

By Walter Franklin Prince, Ph.D.

Principal Research Officer, American Society for Psychical Research

THE editor is responsible for the title, but it is fitting enough, as a part of the work of the psychic investigator necessarily consists in detecting fraudulent and otherwise spurious manifestations. The illustrations of such work which I shall give will be from my own experience. It might be more modest to retell the old stories of how Samuel Johnson exposed the Cock Lane Ghost, how the Seybert Commission caught Dr. Slade, etc.; but these hackneyed accounts would not interest the reader so much as instances comparatively fresh. I will, however, ask permission to tell them in the third person.

Certain principles underlie the detection of spurious psychic phenomena. One of these is *accurate observation*. This is not so easy an art as most people think. To see all that is visible and no more, no matter what others around think they see and no matter what they say or feel, requires unusual immunity from suggestion and the power to keep insulated from emotion.

A few months ago a company of about 15 gathered in the seance room of the "Rev. Dr." Hugh Moore in New York City. Nearly all saw "etherializations," or thinly materialized spirits whom they recognized and whose voices were recalled. They readily accepted the explanation that, because it emanated from his body as "ectoplasm," the spirit had to have the medium near, dimly discernible in the semi-blackness. But there were two investigators there who afterward made independent reports, and these saw no spirits whatever, nor heard any voices seeming to proceed from the objects mistaken for spirits. They saw only phosphorescent thin cloth draped over the medium's left arm and fist. This cloth Moore agitated by the movements of his own body to give the appearance of floating and hovering, or by placing his visible hand and sleeve (presumably with his arm in it) back of the cloth and waggling it. And when a "child," which resembled a large luminous dish-cloth, said "Come to Heaven, mamma"—to them it was a very crude ventriloquial performance.

So too, when the investigator went to a trumpet performance of Mrs. Cecil Cook (noted from her advertising), though he was not able to see anything for the Egyptian darkness, it was perfectly evident that every physical act was within the power of the medium, and that the spirits had the verbal mannerisms of Mrs. Cook herself.

A woman wrote that telekinetic phenomena had broken out in connection with her small daughter. One of the curious things was that the daughter, sitting on a stool, would be tipped back against the door and the mother could not pull the stool back on to its four legs. The investigator went up, and saw it all by not seeming to see. For instance, he saw the child holding fast to the door knob while the mother, with her eyes fixed upon the stool, was vainly trying to force it to the floor.

Another principle of the detection in certain cases is to *test whether the effect actually achieved can be achieved under the circumstances claimed*. In the New York Slave Conspiracy trials of 1741 the girl Mary Burton testified that she looked through the crack under a door and saw a chalked circle on the floor. About this circle she said she saw what looked like rats; she could not tell what they really were. The implication was that they were the heels and toes of negroes being sworn into a conspiracy. It would have been possible within one hour of the giving of this testimony to prove that the girl lied; but not until 160 years after her victims were executed did an investigator actually do this. Experiment with chalk circles of different sizes and at different distances showed that no matter how wide the crack, if the chalked circle could be seen at all so could the whole foot and part of the leg be seen and recognized.

Again, when P. L. A. O. Keeler's spirit control tore up a sealed envelope presented as a test, examination of the pieces showed appearances which the investigator regarded as suspicious. Experiments in sealing and tearing up envelopes showed that these appearances never did and never could arise from this simple treatment alone. But when sealed envelopes were worked open at the flap, with more or less splitting and skinning of the paper, and when these were resealed with a blob of paste and *then* torn into pieces, these characteristic appearances cropped up regularly. The reason for the "capricious" spirit's tearing of the envelope was then plain—it was guilty consciousness of a job poorly done, and the desire to conceal the evidence of fraud.

Again at the same gentleman's seance, another sealed envelope was torn up, and this was supposed by the sitter to be a queer spirit caprice. But the investigator, who thought there was method in the spirit's madness, had prepared the envelope so that the right end-flap could be opened, but in opening would leave a certain betraying effect inside. When the fragments were brought to him to be pieced together, he predicted that they would show the right but not the left end-flap to have been opened. It proved even so; and experiment showed small chance indeed that a perfectly sealed envelope, torn up in the same way, will show the same effects.

Where the claim is made that a certain strange thing mysteriously happens, and you suspect that a particular person brought it about, it is often a good plan to *reenact what you think the person did and then to see if the result is similar*. Thus a flash-light photograph was shown the investigator, picturing a medium sitting between two other men, their backs to the wall and on the wall itself a little higher than his head some writing in chalk, which was supposed to have been made by a spirit. The investigator noticed that the writing began about two inches to the medium's own right of his head but extended two feet or more to his left. Therefore the investigator sat down with his back to the wall and a piece of chalk in his left hand, and in that position wrote from the farthest right to the farthest left possible, behind and over his head. The result was a replica in this particular of the photograph. It was fair to infer that as the limitations of the spirit were those of the medium, the spirit was the medium.

Another maxim of detection when a particular person is suspected is to *consider what under the circumstances a person of that psychological make-up would have been likely to do and to compare with the marks actually in the case studied*. In the case of Mary Ellen of the Antigonish fires, when the investigator suspected her he began to consider how a childish intellect eager to make sensations and not to be found out would act. The girl, who was in and out of the house during stormy weather, would hardly stand on the bed that filled the end of the room; so any fires she set in the wall paper above it would not be higher than she could reach kneeling. But elsewhere she would set some as high as she could reach standing. And it was even so—the various little fires set above the bed never were higher than the girl five feet tall could reach kneeling, but immediately to the right of the bed, where she could stand upright, was a mark of fire nearly as high as she could reach standing. So other particulars in the scheme of what a Mary Ellen would do rang the bell when compared with what was actually done.

But the great method of detection which combines with and completes every other is *inspection of all the details, their analysis and classification and finally their synthesis*—putting them together much as one puts together the pieces of a dissected picture. The Sherlock Holmes method is impossible—outside of novels. With Holmes, a peculiar cigar-ash was a certain indication of the burglar's taste in cigars, whereas in life it might have been the first time that he ever happened to smoke that brand. With Holmes the pipe charred on the left side made it certain that the possessor was a left-handed man, but in life a particular right-handed man might have the idiosyncrasy of lighting his pipe with that side presented to the gas-flame. Men in fact are not automata and in fact similar effects may come from a dozen causes. But by the collection, analysis, classification and final combination of details, so that each finds its appropriate place, psychic fraud or delusion can usually be brought to light and demonstrated.

Take "The Great Amherst Mystery" case, for example, of 1878-1879, another Nova Scotia poltergeist case which received much newspaper mention at the time and was the subject of a book which up to 1916 had reached its tenth edition. The book maintains that without a doubt ghosts sent objects hurtling through the rooms, overturned furniture, stuck pins into Esther Cox, the central figure of the phenomena, engraved threatening messages on the wall plaster, kindled fires, and all the rest of it. The author of the book spent some time in the house and was so thoroughly convinced

ONE of the editors, in writing two months ago of certain types of psychic manifestations remarked, in effect: "Here we have a phenomenon lending itself readily to deception, and nothing is gained by ignoring this. But nothing is gained, either, by ignoring the obvious fact that in many cases the performance is carried on without the volition of the medium." The separation of the grain of true psychic phenomena from the chaff of fraud, trickery and misunderstanding is, in some ways, the most fascinating angle of psychic investigation. The present author, whose portrait adjoins these remarks, tells us some of the things which the psychic detective does, and some of the ways in which he does them.

With apologies to Dr. Prince, we remind our readers that he is the man who spent a few jolly evenings on the trail of the Antigonish "ghost." The apologies are in order, for Dr. Prince feels about the Antigonish incident much as an eminent mathematician might feel if, after a lifetime of valuable research unknown to the public at large, he should suddenly become rich and famous through the invention, in an idle moment, of a Pigs-in-Clover puzzle. This particular investigation was a matter of routine, of negligible scientific consequence—for it was almost a certainty that it would turn out as it did. Like the eminent mathematician, Dr. Prince would rather be known by some of his real achievements. It is, of course, because of these, and not at all because of his recent newspaper publicity, that we have asked him to contribute this article.—THE EDITOR.

that he in turn has convinced thousands. Yet forty years later, by the process of analyzing the details and classifying them in the light of what is now known of abnormal psychology, the "psychic detective" was able to demonstrate with a wealth of proof convincing to any psychologist at least, that Esther Cox was a hysteric. She had developed dual personality, with accompanying forgetfulness in her normal state of what she did in her abnormal state; and the tricks were really done by her in the latter condition. Fortunately, in his naïve fashion the chronicler told something of Esther's history previous to the outbreak. Consequently the shock which usually precedes development of dual personality was accounted for; various symptoms which mark the condition were brought together; the speedy sequence of the peculiar happenings was shown, and also the way in which many of them reflected and dramatized and reenacted the details of the shock itself. It was shown that no one actually saw the beginning of the flight of objects through the room and that Esther was always conveniently near. They occurred when she was in a place to remind her of the distressing facts connected with the shock, and they ceased when her environment entirely changed. Besides, the original manuscript diary upon which the writer based his book was discovered, and exaggerations and even contradictions were made unmistakably clear.

Demonstrations of the character we are discussing are especially important in the case of impositions upon the public of large extent and of long duration. I may mention the case of the most noted of all the living so-called spirit photographers, who has been practising his art for more than fifty years and has counted thousands among his dupes, which are still being added to in spite of the full exposure made. The investigator examined more than four thousand photographs produced by this man. He was able, by the process already outlined of dealing with a large number of details, to produce so palpable a demonstration of fraud that a well known English psychical researcher remarked that it was a wonder the pictures ever deceived anybody, they were so evidently spurious. One had the feeling of having done his work too well, for thousands were deceived by them, exactly as thousands are being deceived by frauds in England today.

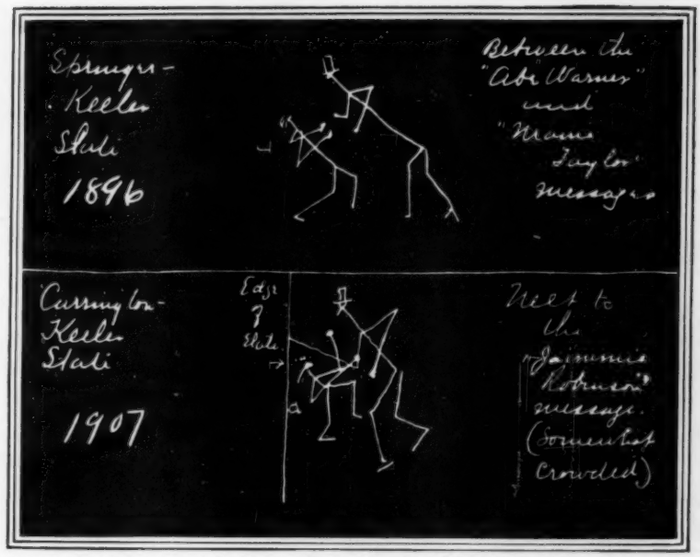
This man, for the benefit of a wealthy sitter, produced many hundreds of photographs purporting to be those of a clergyman who died some years ago. This spirit is represented as doing all sorts of things —dancing, walking, gesticulating, playing the piano or violin, viewing the wonders of the Yosemite Valley, parading in the robes of a bishop, etc., etc. Almost infinite variety occurs—except in relation to the head, which never varies an eighth of an inch from two angles, precisely those of the two photographs of the clergyman owned by the sitter. The head itself varies only in particulars which could easily be the result of manipulation, and which palpably show the effects of manipulation, such as bleaching, retouching, paring away a portion of the hair on the forehead, and so on. Probably from a reluctance to show a spirit wearing spectacles, generally these useful articles are erased. Sometimes this is done imperfectly so as to show portions of the bows; or if completely, necessarily so as to destroy a portion of the eye and show a curious white line on the temple and a corresponding notch in the hair where the bow had been.

Some feeble attempt was made to defend these photographs on the claim that the spirit was influenced by his memory of the life photographs, but he certainly could not have remembered himself as indulging in a dance which was not invented until after his death, nor as occupying a suit of George Washington recognizable from a famous painting, nor as having his head attached now to a short thick body and again to a long thin one. Of course these peculiar effects were the result of attaching the head to bodies with which it never belonged, and in some cases the line of junction was left apparent. In many of the photographs there was double or triple lighting, resulting from one or two figures being introduced into a scene without regard to consistency in this respect. There were photographs of the "temple" in which the clergyman is supposed now to be preaching in Paradise, and which corresponded exactly with one of the buildings of the Panama-Pacific Exposition—even to the Grecian frieze of nude figures. Another building, supposed to be associated with him in his present abode, also corresponds to one of the Exposition Buildings and the reflected lights in the street outside show that it was a rainy night in heaven when it was taken. Another photograph representing presumably unknown spirits caused a chord of recollection to vibrate in the mind of the investigator, and he succeeded in finding the original as the frontispiece in an old copy of the *Cosmopolitan Magazine*. Among the singular anomalies of the series were the heavenly scenes showing plainly in the original photographs the dots of the engraver's "screen." Another mystic photograph contained oddly grouped faces which proved to have been cut out and rearranged from Hoffmann's celebrated picture of Christ in the Temple. These are only a few of the multiplied proofs that the most celebrated of the American spirit photographers does fraudulent work. But his work goes on.

In connection with the same series an example may be given of what appeared on the face of it to be a convincing testimony, but which was riddled by analysis. A certain person sat to this photographer and afterwards received by mail a photograph which she pronounced to be her own and the *exact replica* of one that had been taken of her some years previously, but which had been unfortunately destroyed. Of course this misfortune made it impossible to make a direct comparison, but it still chanced that the lady's accuracy could be tested. For in a second letter she stated that another remarkable fact was that the later photograph showed her wearing the garb of a religious order which she had thought of joining, but which garb she had in fact *never worn*. When the photograph was examined it was found that the garb constituted the whole picture with the exception of a very small part of the features taken in profile. Her picture was actually taken by the spirit photographer; and the outline of her forehead, nose and mouth probably have not changed much in a few years. As nothing else in the later picture, by her own second statement, is to be found in the earlier one, the marvel as announced in her first letter seems quite to have disappeared; there could have been no difficulty in cutting out a small portion of her profile portrait and introducing it into the hood of the vestment. If we had at hand the robes of the order which the lady once thought of joining we might not, judging by her already demonstrated inaccuracy, find quite so much resemblance as she declared. If there was not actually on her part a forgotten remark in reference to her former thought of becoming a "*religieuse*," the rest is coincidence, and in thousands of cases some coincidences must occur.

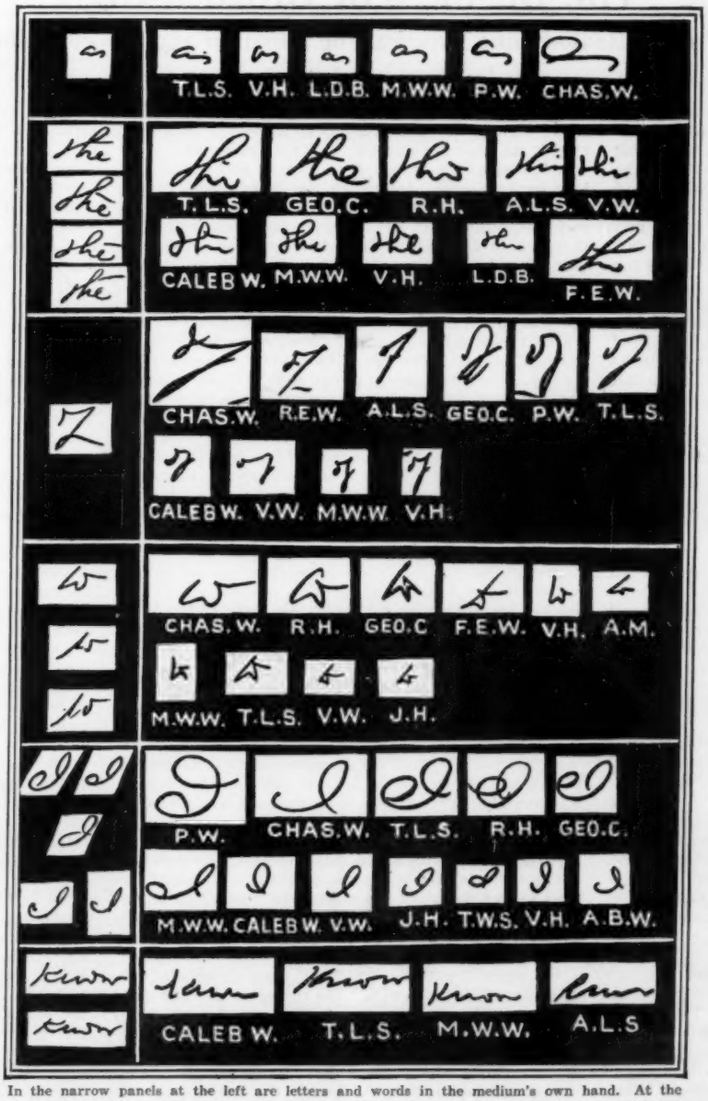
Another fraudulent personage who has loomed largely in the public eye happens to be the brother of a spirit photographer. He is one of the most noted of American professional mediums, and specializes in producing what are supposed to be spirit writings which occur between closed slates. A few years ago a lawyer residing in a city of the State of New York, and who had for years experi-

(Continued on page 71)


Between the "Abi Warner" and "Mamie Taylor" messages
1896
Cumming-Keeler Stadi
1907
Next to the "Jaimmie Robinson" message. (Somewhat crowded)

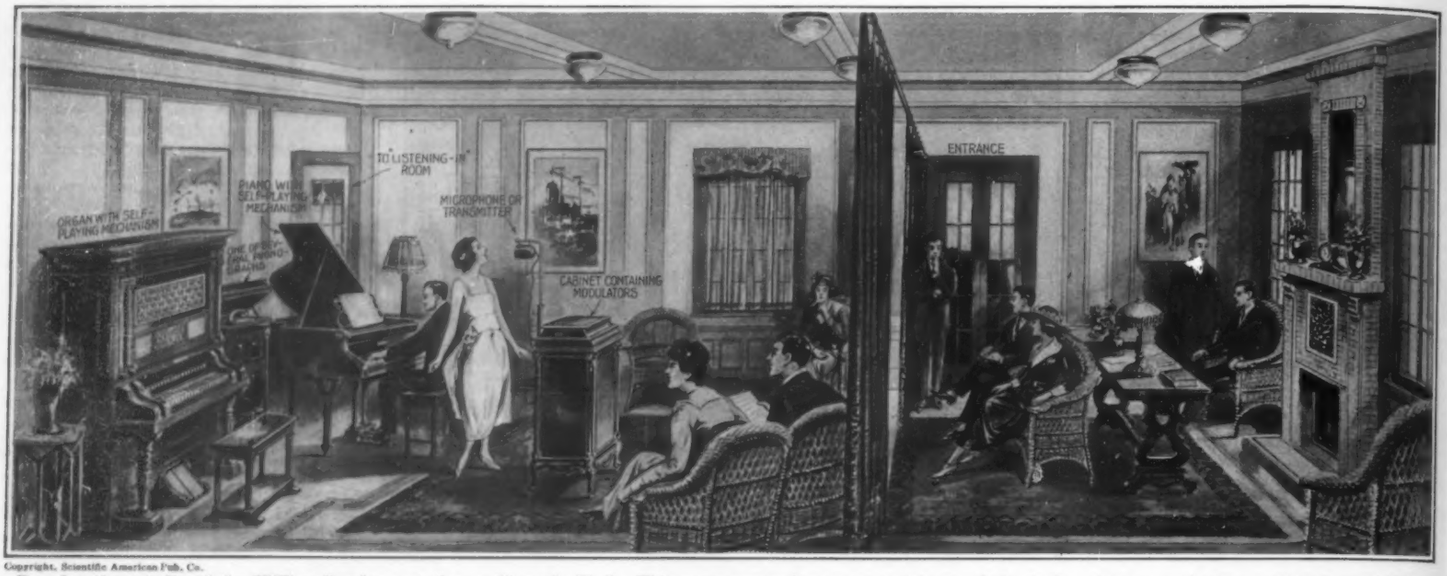
These two pictures adorned "spirit messages" delivered at different times eleven years apart, to different people, by different "spirits." The only thing that was the same was the medium—and the curious picture of the tall man and short man fighting

Evidence that the communicant was really the medium


T.L.S. V.H. L.D.B. M.W.W. P.W. CHAS.W.
T. L.S. GEO.C. R.H. A.L.S. V.W.
CALEB W. M.W.W. V.H. L.D.B. F.E.W.
CHAS.W. R.E.W. A.L.S. GEO.C. P.W. T.L.S.
CALEB W. V.W. M.W.W. V.H.
CHAS.W. R.H. GEO.C F.E.W. V.H. A.M.
M.W.W. T.L.S. V.W. J.H.
P.W. CHAS.W. T.L.S. R.H. GEO.C.
M.W.W. CALEB W. V.W. J.H. T.W.S. V.H. A.B.W.
CALEB W. T.L.S. M.W.W. A.L.S

In the narrow panels at the left are letters and words in the medium's own hand. At the right are excisions from numerous communications, through this medium, from different "spirits." The investigator finds correspondences too numerous to list, but among which those in the "th" of "the" and in the word "of" are especially marked

Spiking the claim that spirit writings show the penmanship of the communicant, and proving that they show that of the medium



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Broadcasting studio of the WJZ radio-phone station at Newark, N. J. This same general arrangement is now being followed in several of our radio-phone stations for the comfort and convenience of the radio-phone entertainers

The Business of Broadcasting

A Survey of the Present Radio-Phone Broadcasting Situation and a Speculation as to Its Future

By Austin C. Lescarboura

IT was one of those sweltering spring evenings, not so long ago, when the weather insisted that it was summer and we, with our heavy clothes, insisted that it was still early spring. We fairly melted away in the so-called radio-phone broadcasting studio, which had all the earmarks of a cloakroom, despite a lonesome oil painting, a few stray rugs tacked on the walls, and several yards of draperies thrown here and there but hardly in sufficient volume to hide the nakedness of the place.

Now the door, leading to a fire-escape, had been left open in order to get a breath of air. There was a death-like silence in the studio, save for the editor of a well-known weekly who, at that moment, was addressing the radio audience. He sat with his back to us and to the door, with the microphone stand in front of him and with a small table at his left.

We were listening attentively to his talk on the Chinese civil war and the exploits of General Chop Suey and General Yaki Main, or whatever their names happen to be. Suddenly, without warning of any kind, there was a piercing, awe-inspiring shriek, issuing from the general locality of the fire-escape door. A hurried survey of the situation indicated that civil war had broken out between two tom cats. The vanquished cat, panic-stricken, jumped into the studio, raced towards the farthermost corner where the announcer, who had been sitting down, rose to catch the intruder. The cat turned around, jumped on the table, nearly knocked the microphone over, spat at the editor then trying to speak, and finally ran out of the studio.

The cat, although unannounced on the evening's program, did broadcast after all. For the next few days numerous inquiries were received at the broadcasting studio, asking what the awful shriek might be and whether it was a thrilling and very realistic obligato to the discourse on Chinese battle tactics.

All of which is by way of pointing out the responsibility that rests on those who do the broadcasting, and the need for real broadcasting studios. Every sound, every word, every statement uttered in the studio, is public property. The audience runs into hundreds of thousands; and it is a highly critical audience too, even if it receives the entertainment gratis.

The story is also told here in order that you may better appreciate the remarkable changes just recently made in that very same studio during the past month. From the long narrow cloakroom which served as a broadcasting studio for the first six months of the new art, the studio has been moved into a large, comfortable, beautifully decorated room in another part of the building, especially arranged for radio-phone broadcasting. When the visitor, who was familiar with the former studio, walks unexpectantly into the new studio and is positively amazed at the strides made in handling the programs and in catering to the convenience and comfort of the performers, he realizes once more that Rome will not be built in a day or a week or a month, even if no time is being lost in its development.

It is a spacious, beautifully arranged room, this new broadcasting studio, located on the ground floor of the Westinghouse plant in Newark, N. J. After passing the rigid inspection of two bulky gendarmes who guard the entrance to the studio, the visitor passes through a pair of swinging glass doors into a vestibule, on the walls of which are a pair of lights of different colors. These lights indicate whether the studio is "standing-by" but still "in the air," sending out its silent carrier wave; actually broadcasting; or shut down. Passing through another pair of glass doors the visitor enters the studio. A colored attendant comes up to take the visitor's hat and coat, while a lady attendant takes care of the lady visitors. Comfortable settees and over-stuffed chairs, a fireplace, handsome rugs, attractive hangings, delightful color scheme—all these things give the studio the atmosphere of a living room rather than that of a radio station. The only visible trace of radio equipment is a small cylinder, dangling from an adjustable stand, which contains the microphone. The modulators or devices which amplify the voice or music before it is impressed on the radio waves emitted by the transmitter on the roof of the building, are contained in a cabinet which has the outward appearance of the usual high-grade phonograph.

If anything, the atmosphere, comfortable and reassuring as it is for the performer, is positively uncanny if one stops to think what it all means. Here, in this living room or drawing room, we have the means of entertaining hundreds of thousands of invisible listeners scattered over many hundred square miles. We have ready access to thousands of homes, clubs, schools and churches. Yet we do not have to raise our voice to do so, providing we are within a reasonable distance of the little microphone transmitter.

The broadcasting studio is practically sound-proof, so there is no interference from outside noises. The shrieking cat episode is now a remote possibility. Despite the sound-proof nature of the studio, the ventilation is perfect. A series of openings along the top of one wall insures a plentiful supply of fresh air, while the vitiated air is drawn off as rapidly as it is formed.

So much for the magnificent appointments of the WJZ broadcasting studio. The technical end has quite kept up with the studio end. The great problem of broadcasting has been the obtaining of proper modulation, or the molding of the radio waves, so to speak, in accordance with the sounds to be transmitted. Certain instruments like the piano, the cornet and the saxaphone have proved extremely troublesome, causing "blasts" or blurs in the transmitted music. The voice, especially the soprano and the tenor variety, has been readily handled, but considerable difficulty arose in coupling the voice with a musical accompaniment. Little by little, however, the broadcasting personnel have learned how to place their microphone or microphones with relation to various kinds of singers and different varieties of musical instruments. There was a time not long since when four or five instruments were about the limit for a radio-phone orchestra, and the addition of instruments simply meant an impossible muddle. With the present microphones it is now possible to handle the usual full orchestra with pretty fair rendition at the receiving end.

Most broadcasting studios have various means of checking up on their transmission. To begin with, there is generally a receiving set in some other part of the building, where the studio personnel can "listen-in" to what is being transmitted. In the instance of WJZ, there is a separate room right off the studio, which enables the announcer to check up on the transmission, while the operators in the radio station on the roof also keep tabs on the modulation. Then there are the outside critics, who telephone in regarding the reception of selections at a distance. Often the microphone must be shifted during a talk or song or musical selection, in order to improve the modulation.

And what has been going on at WJZ—that well-known broadcasting station at Newark—is going on in other radio-phone broadcasting establishments. With the experimental work pretty much completed and with the art brought down to something like a routine basis, the various broadcasting organizations are now rearranging their studios so that they are no longer mere improvisations. Not so long ago they were laboratories in fact, if not in name, but now they are studios in every sense.

All this broadcasting work costs money—real money and plenty of it. Little wonder, therefore, that the question often comes up in and out of radio circles: "Who is going to do all the broadcasting once the market is flooded with radio equipment?"

It is generally known that the organizations now engaged in radio broadcasting are for the most part large radio manufacturers who are doing a phenomenal business. Indeed, so great has been the volume of radio sales that the broadcasting expenses have been a mere incidental, even though the better and larger type of broadcasting station is said to cost anywhere from $2,000 to $5,000 per month to operate. Meanwhile, the performers who entertain us nightly by radio are volunteering their services for the present, not only for whatever publicity—that intangible yet fascinating something—which they may obtain from a radio-phone concert, but also through purely altruistic motives.

In a previous issue the writer pointed out the unfairness of the present radio-phone broadcasting situation. To several large electrical and radio companies has been left the burden of broadcasting, while dozens of

old radio companies and thousands of newly organized companies have been reaping the harvest. Were the broadcasting stations to close down tomorrow, nine-tenths of the equipment now in existence would be junked; for, let us not forget, there are relatively few who are interested in radio for its own sake.

Hence the present situation is not altogether a sound one. A time must come and come soon when talent will not render its services free of charge. The cost of obtaining singers, lecturers, musicians and others will be considerable, and will have to be added to the present maintenance costs.

As for the saturation of the radio market, a careful survey of the situation does not indicate any danger of a serious slackening up in the present brisk trade. There are at this writing perhaps 800,000 radio receiving sets in actual use, and it is estimated that there is a potential market for at least two million sets within the next few years. Again, as in the case of automobiles, the radio sets, while they do not exactly wear out, go out of style, or at least their users outgrow them. The second-hand equipment is not as yet a problem, so far as the radio manufacturer is concerned, and probably will not be for a long time to come.

Thus as far as the radio market is concerned, there is no immediate falling off to any great extent, although during the present summer the sales must necessarily be less than during the past winter and spring and certainly less than during the coming fall and winter. Cold weather is conducive to radio; warm weather is against radio. Those concerns which are now doing the broadcasting as a part of their radio work are likely to keep up their activities indefinitely.

But there is another side to the broadcasting situation, and that is the newspaper side. Many of the more progressive newspapers throughout the nation have taken up broadcasting and are operating on regular program basis. The newspapers are sending out the news of the day, stock quotations, market reports, weather forecasts, special talks, and timely sporting news. Some newspaper broadcasting stations have even gone in for complete musical programs. The *Detroit News* station, WWJ, represents perhaps the highest type of newspaper broadcasting service, with excellent programs, remarkable modulation, and great range.

Then there are the Government broadcasting activities. As time goes on the Government is going to find more and more uses for broadcasting, and all kinds of invaluable information will be given out to the citizens of the nation in this manner. Even now, health talks and other helpful information are being broadcasted for the benefit of all those possessing receiving sets.

Still another source of broadcasting service — the universities. Certain institutions, such as the University of Wisconsin and the Union College of Schenectady, N. Y., have been doing their share of broadcasting. In the near future we can count upon the more progressive universities for special talks of a popular yet instructional nature, and even courses of lectures for home study.

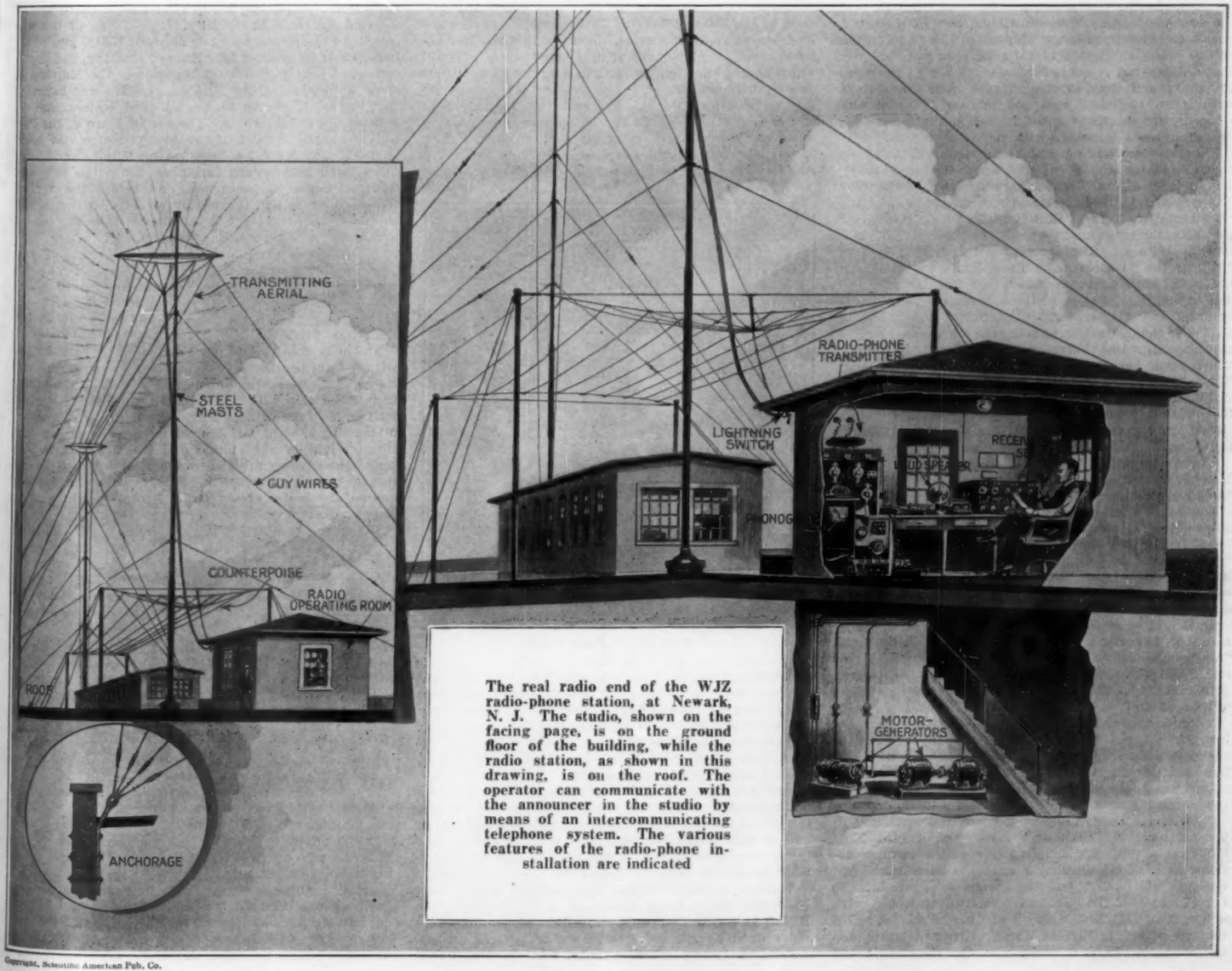
However, the foregoing sources of broadcasting do not insure for us the best music and the leading artists, such as we enjoy today. Sooner or later we shall have to pay for the high-grade entertainment such as we have been getting free of charge during all these months, although there will be plenty of gratuitous broadcasting so that the receiving set need never be silent. The problem simmers down to how the broadcasting studio, employing the finest talent, can pay its expenses.

For a time it was generally believed that the broadcasting expenses could be derived from publicity talks cleverly interlarded among musical numbers, news, interesting talks, and so on. The plan was to have the broadcasting station operating during the entire day, with certain times set aside for advertising matter. This plan, however, is not practical, and it is almost certain that the radio laws soon to be passed will make it necessary for anyone to use special wave lengths and limited power for publicity talks of any kind.

Now, if the expenses cannot be collected at the transmitting end, how about the receiving end? Unfortunately—or fortunately, perhaps—radio is a public thing. There is no simple way to erect a fence about a radio performance and to charge admission to those wishing to hear the performance. Still, the expenses must be paid for from some source.

Radio men are fully cognizant of the foregoing facts. They admit that while newspapers, universities and other institutions may find it well worth their while to broadcast news and other matter, the musical programs may yet have to be abandoned in time, because of their cost. Several ways have been suggested for charging a fair price or subscription to all those wishing to receive high-grade radio-phone programs. One method is to use some form of wave-changing device at the transmitting end, which constantly alters the wave length and makes it necessary for the audience to use a similar wave-changing device to keep the receiving set in tune with the transmitter. Such a scheme calls for synchronized mechanisms, but with the excellent spring motors now available as the result of the phonograph industry, this is a small obstacle. Now then, with this plan in operation, it would be possible for the special broadcasting stations, operating at great expense, to have a regular subscription service. Anyone paying the subscription price would receive a wave-changing

(Continued on page 70)



The real radio end of the WJZ radio-phone station, at Newark, N. J. The studio, shown on the facing page, is on the ground floor of the building, while the radio station, as shown in this drawing, is on the roof. The operator can communicate with the announcer in the studio by means of an intercommunicating telephone system. The various features of the radio-phone installation are indicated

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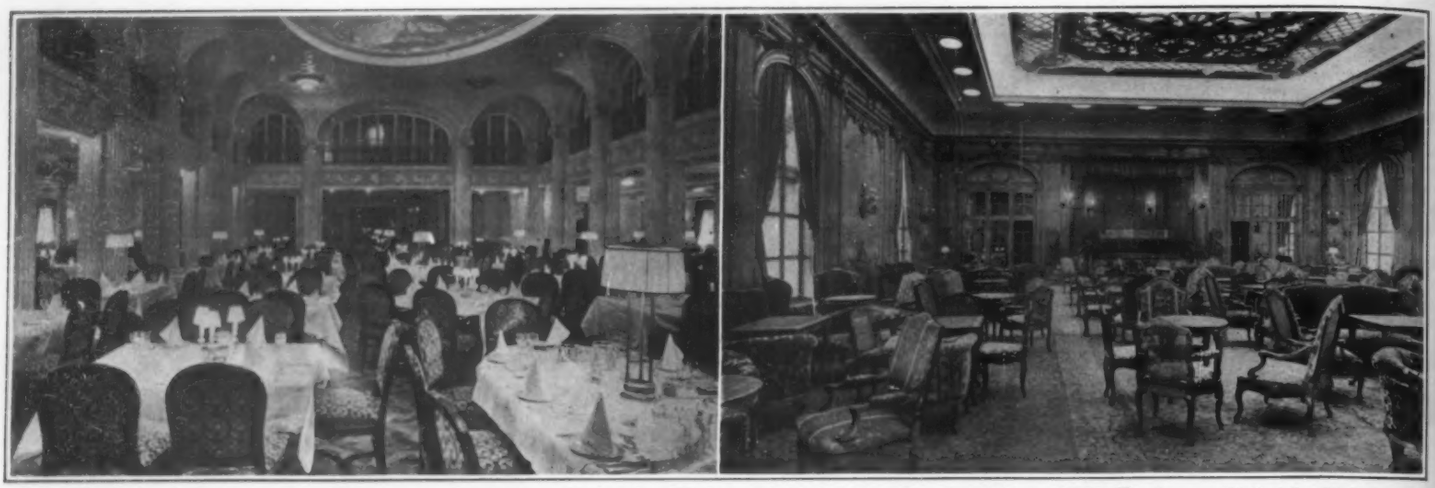


Left: **The main dining room seats 652 persons. It measures 98 feet by 117 feet, and 31 feet from floor to ceiling.** *Right:* **The lounge, 54 feet by 76 feet and 26 feet from floor to ceiling. This noble room is entirely free from interior supporting columns**

"Majestic"—The Latest and Largest of Ships

The High-Water Mark in the Development of the Trans-Atlantic Passenger Steamer

NOT in this generation, if ever, is it likely that a larger ship than the "Majestic" will be built for commercial service. We base this statement on solid grounds. In the first place, the depth of channels and the accommodation of piers in the harbors of the world put an embargo upon larger ships than this; and, in the second place, the practical shipping man will tell you that a 35,000-ton vessel is large enough for all practical purposes; and that anything larger than that brings with it an increased risk and anxiety, without any compensation in the way of increased dividends—the profits, indeed, lie rather with the smaller ship.

The "Majestic" is the latest expression of that keen competition in size, speed and luxurious accommodation, which was at its height when the World War broke loose. In 1913 the speed record was held by the "Lusitania" and the "Mauretania," which had made the Atlantic crossing at speeds, respectively, of 25.5 and 26.01 knots. The record for length was held in 1913 by the "Imperator." The "Aquitania" followed in 1914. Both of these vessels are slightly over 900 feet in length. The record for tonnage up to 1914 was held by the "Imperator," with 52,000 tons; but in that year the distinction of being the longest and largest ship passed to the "Vaterland" (now the "Leviathan"), which made her first trip in the summer of that year. This vessel is 950 feet long by 100 feet beam, and her displacement is given as 54,000 tons. She is now owned by our Government, and is at present being re-conditioned at a cost of $6,000,000 for the United States Shipping Board.

The "Imperator" was built at the Stettin works, Hamburg, and while she was under construction the keels were laid, on two adjoining building ways of the Blohm and Voss Company, Hamburg, of two sister-ships—the "Vaterland" and "Bismarck." The "Vaterland" was in New York when war was declared, and the "Bismarck" was only partially completed. But little work was done upon the "Bismarck" during the war; but subsequently she was assigned to Great Britain, and completed by her builders.

It should be noted just here that at the commencement of her construction the "Bismarck," now the "Majestic," was lengthened by the introduction of two additional frames, so that she might be the largest ship in the world, her length being now 956 feet, or within 44 feet of the thousand-foot mark.

There is something in mere size that appeals to man's imagination, and a glance at the accompanying diagram shows how, in length and bulk, the trans-Atlantic liner has been growing during the past 50 years. The ships shown are those of the White Star Line, and each of these was the star ship of the company in its day. In 1872 we have the "Oceanic," 420 feet in length, and 10 years later the "Germanic," 455 feet in length. This ship was notable for her greatly superior accommodations, and indeed she may be said to have introduced the age of comfort and luxuriance in trans-Atlantic travel. In 1892 the "Teutonic" was the star ship, with a length of 566 feet, a speed of over 20 knots, and a tonnage of nearly 10,000. The first trans-Atlantic ship to reach the 700-foot mark was the "Oceanic"; and the "Celtic," coming out a little later, was also a 700-foot ship; but with a greater beam and depth, she reached a tonnage of nearly 21,000. Ten years later came the "Olympic" of 46,439 tons, and only a few feet short of the 900-foot mark. This majestic vessel, after 10 years of faithful service, during which she has enjoyed great popularity, must now give way to a vessel which exceeds her by 73½ feet in length, and by 10,000 tons in displacement.

It is probable that the "Majestic" will continue to be the largest ship afloat for at least a generation to come, unless some rival company should consider that, merely for advertising purposes, it would be worth while to build the first 1000-foot ship. So far as the economics of the thing go, it is generally agreed among shipping men that these great vessels, apart from their advertising effect, are not so profitable, and certainly not so convenient in operation, as ships of smaller size. The White Star Line consider that a ship of 35,000 tons, such as the "Homeric," marks the limit of size, beyond which it is not desirable to go. The monster vessels are always a source of anxiety to the dock superintendent. The great bulk below water renders the pull of the tides upon the hull a very serious matter, and in high winds the huge area above water results in an accumulated wind pressure that may be as difficult to control as the thrust of the river current.

Corner of the Palm Court

The hull of the "Majestic" was designed by Dr. Ernst Foerster, Chief Naval Architect of the builders, the Blohm and Voss Company. The lines of her hull were determined as the result of tests of several models, carried on in two different tanks, with the result that the last model showed a saving of 18,000 horsepower over the first model. This economy was due largely to giving the after part of the ship what is known as a "cruiser" form. By this change, also, there is considerable increase in stability. The design of the ship called for the development of between 15,000 and 16,000 horsepower on each of four lines of shafting, and it was estimated that with 63,000 horsepower the ship would show a speed of about 23½ knots. We are informed that on trial, thanks to her oil-fired boilers, she developed about 24½ knots. The turbines are of the Parsons type, and consist of one high-pressure, one intermediate, and two low-pressure turbines for driving ahead, and four astern turbines. Since the ship was designed some 10 years ago, and before the various reduction gears had thoroughly established themselves, the drive is direct; but it is believed that the present arrangement of three-fold expansion, high, intermediate and low, gives this installation the maximum of economy possible with the direct drive. These turbines are necessarily very large, the low-pressure astern weighing 375 tons. The blades in this turbine run to a length of two feet, and in all the turbines there are no less than 9000 blades.

Steam is provided by 48 Yarrow water-tube boilers, with a total heating service of 220,000 square feet, and the working pressure is about 260 pounds to the square inch. The ship, although originally designed as a coal burner, has been equipped with the White, low-pressure, oil-burning system. It should be mentioned that the total weight of the engine and boiler plants is 8500 tons. Reckoning all the weights devoted to motive power, including hatches, bunkers, auxiliary machinery, engine and boiler crew, etc., the total weight may be put down at 22,000 tons.

When the "Majestic" is fully loaded with fuel and supplies, with a maximum complement of passengers, her displacement is about 63,000 tons. During the passage her consumption will be about 5700 tons of oil, and this added to the fresh water and provisions for the passage makes a total of 8000 tons. From day to day this weight is reduced by consumption, and in order to compensate as far as is necessary for stability, 3300 tons of water are admitted into the compartments.

The heating of the passenger staterooms, assembly rooms, etc., is by steam, but all first-class staterooms are also electrically heated. Matters are so arranged that each passenger can regulate the heat according to his own wishes. The electric-power installation will compare favorably with that of a small town, since it consists of five turbo-dynamos, each developing 288 kilowatts at 115 volts, when running at 200 revolutions per minute. In addition to the main electric station there is an independent Diesel emergency installation of 80 horsepower, which is located about 20 feet above the bulkhead deck. This serves 800 emergency lamps distributed throughout the ship; it is also connected to the boat hoisting and lowering machinery, the navigating and signaling elements, and the emergency wireless.

Before passing on to a description of the passenger accommodations, mention should be made of the fact

that in the boiler rooms one fireroom attendant has charge of three boilers, or 15 out of the total of 240 furnaces; with three watches in 24 hours, 48 attendants are sufficient to man the fires. Also in the firerooms are 96 cleaners, making a total fireroom staff of 48 men, as against 377 men, who would have been necessary had the ship burned coal. When burning coal the ship would have required 12 chief stokers, 197 firemen and 178 coal passers. In a comparison of weights we find that with an oil bunker capacity of 8200 tons, the "Majestic" will carry nearly enough oil for the Atlantic round trip. If she were burning Welsh coal, she would use up 1000 tons a day, or 6000 tons for one passage across the Atlantic.

The passenger accommodations of the "Majestic" are on a superb scale in regard both to size and sumptuousness. If the reader wonders how such vast assembly and dining rooms can be housed in a ship, he is asked to remember that the ship has nine decks; that she is 100 feet wide, 100 feet deep, and nigh upon 1000 feet in length. Of the steel decks, five are in the lower or main part of the hull. They extend for its full length, are divided by many bulkheads, and are formed into a series of compartments connected by watertight doors, which may be operated from the bridge. Above the fifth deck are four additional decks for cabins and public rooms. These occupy the middle third of the ship's length.

Although seven of the nine decks are given up to passengers, to avoid interference with these accommodations the smokestacks are divided below the passenger decks, and are brought up the sides of the ship, to meet again above the upper rooms. Thus, a clear passenger space is attained throughout the center of each deck, and it is possible, when standing at one end of the main saloon, to obtain an unobstructed view, through the great assembly rooms, of 250 feet.

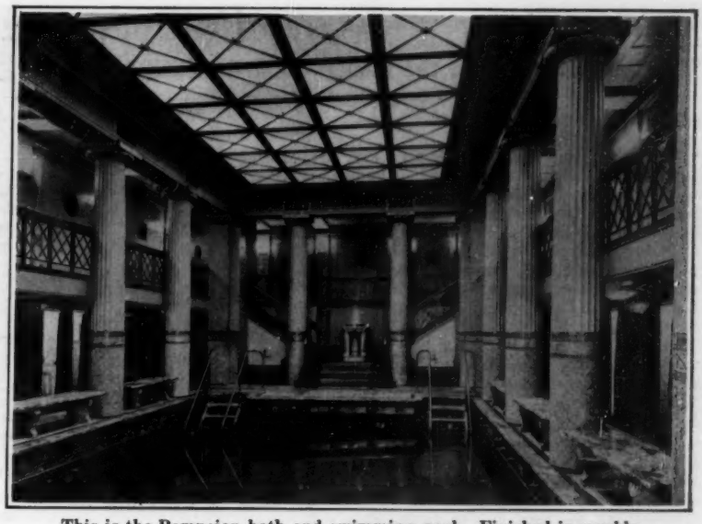
A continuous walk through all the corridors and public rooms on board would mean a trip of nine miles. There are seven and a half acres of decks, and if a passenger wishes to take a constitutional tramp around the promenade deck, he can cover a mile by making that circuit four times. The main dining room will seat 652 persons, is 98 feet wide by 117 feet long, and 31 feet high, and in case of overflow, 200 more persons can be accommodated in the "A la Carte" restaurant. The lounge, or main saloon, is 54 feet wide by 76 feet long, and its ceiling, 26 feet above the floor, is carried on the walls of the room, without any interior supporting columns. With its oak-paneled, hand-carved walls, and its glass roof, this forms a truly magnificent apartment. Another notable room is the Palm Court and Ritz Dining Hall, the effect of which is shown in one of our illustrations. No great modern ship is complete without its swimming pool, and one of the most striking features of the "Majestic" is the Pompeian bath. This has been carried out in very close conformity to the architecture and mural decorations of the buried Roman watering place. It is decorated with marbles and richly colored mosaics. Around it are grouped Turkish and electric-ray baths.

The total capacity of the "Majestic," for passengers, is 4100. To accommodate them there are 1245 staterooms, of which 472 are first-class. There are various suites of many rooms, the two largest having eight rooms each, the central apartment in each of these being a private sun verandah, with which the other rooms connect.

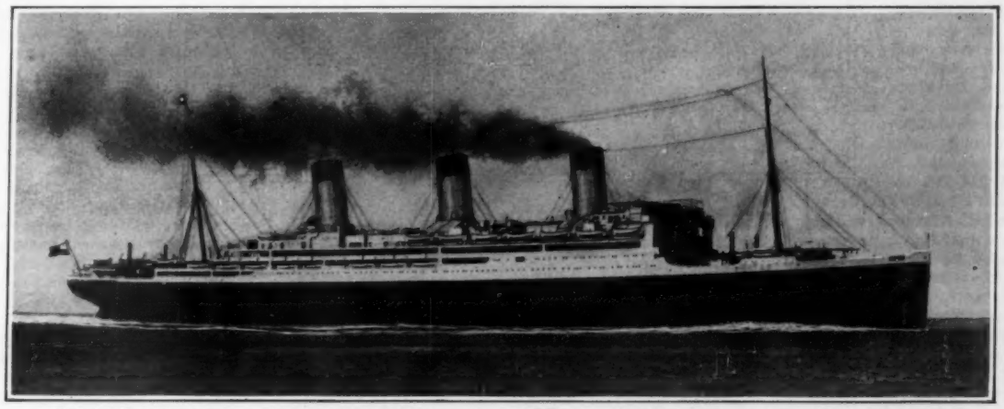
Unusual attention has been given to the second and third cabin accommodations, the second cabin lounge, reading room, and smoking room, being of a size and furnishing equal to that of first-class liners of the previous decade. The second cabin dining room, for instance, seats no less than 500, and there are the usual lounge, reading rooms, and smoking rooms.

Particularly interesting is the fact that the third-class accommodation also has its lounge, its smoking room, its dining saloon, all tastefully finished, and that the sleeping accommodations include many well-lighted, two, three, and four-berth staterooms.

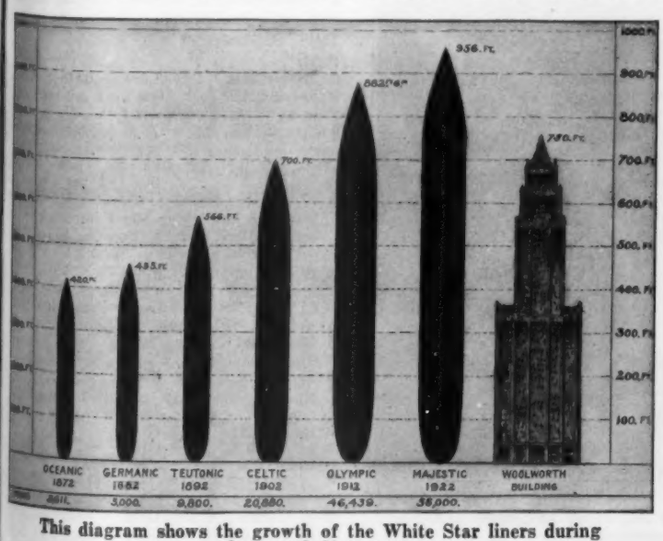
Such is the latest of the great Twentieth-Century passenger liners. Whether she will mark the limit of size among steam-driven ships, the future alone can tell.



This is the Pompeian bath and swimming pool. Finished in marble and rich mosaics



"Majestic," the largest liner, is of 56,000 tons gross; 63,000 tons displacement, and over 24 knots speed



This diagram shows the growth of the White Star liners during the past half century

Determining the Penetration of Wood Preservatives

THE effectiveness of any wood preservation treatment is measured very largely by the depth to which the preservative penetrates. This can be determined by the following tests, which are used by the Forest Products Laboratory:

The presence of creosote oil is indicated by the dark discoloration, and the degree of penetration may readily be determined by taking a sample at a point free from checks and other imperfections and at a considerable distance from the end. This may be done either with an ordinary half-inch bit, or with an increment borer, which brings out a core of wood that shows in cross section the depth of penetration and is easily examined. The observation should be made at once, because the oil spreads rapidly over the cut surface. In order to prevent infection, the hole in the treated piece should be tightly closed with a creosoted plug.

As zinc chloride is colorless, the depth of penetration of this preservative must be ascertained by chemical means. After cutting the stick in two or getting a sample with the increment borer, the freshly-cut surface is dipped for not to exceed 10 seconds, in a 1 per cent solution of potassium ferrocyanide, and the excess solution is removed by blotting paper. The sample is then dipped into a 1 per cent solution of uranium acetate, and dried. The treated portions will be whiter than the natural wood, and those untreated will have a dark red or a maroon color. This method does not give very sharp contrasts on wood which is reddish in color, like red oak, but otherwise is very satisfactory and affords a permanent record.

Another method (developed by Galen Wood) consists in spraying over the freshly-cut surface a mixture of equal parts of a 1 per cent potassium ferrocyanide solution, a 1 per cent potassium iodide solution, and a 5 per cent solution of soluble starch. This colors the treated portion a very dark blue, but does not affect the untreated wood. Although the color fades in time, it may be brought back by spraying again.

Sodium fluoride is colorless, and no satisfactory method of showing its presence in wood has been devised.

Mercuric chloride is also colorless, but dipping the wood in a solution of hydrogen sulphide turns the treated area black.

As individual pieces may show an abnormally high or low degree of penetration, a sufficient number of tests should be made to obtain a fair average. Samples should be taken at a considerable distance from the ends of the stick, in order that they will not be affected by the heavy longitudinal penetration from the ends.

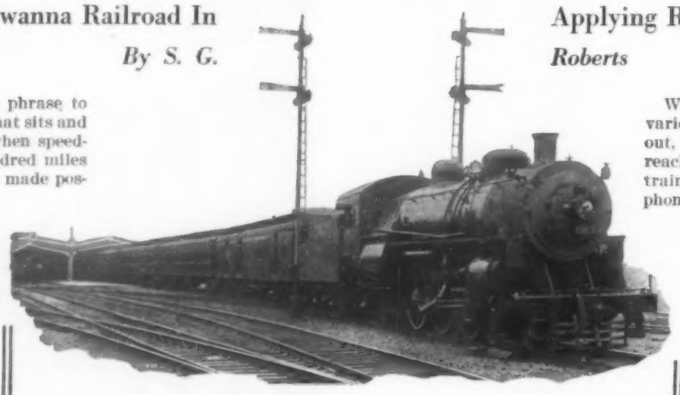
Platinum Discovered in Brazil

THAT platinum has been discovered in the State of Parahyba do Norte, Brazil, is reported to the Department of Commerce by Consul Cameron at Pernambuco. The deposit is on a mountain ridge three miles from the main automobile road leading from Campina Grande to Patos. Regular truck lines now operate over this route, and it is understood that a branch road from the main line to the deposit could be easily constructed. For the present the owner proposes to establish an extracting plant at the deposit and bring the ore out by truck. His funds are limited, however, and he may require outside capital.

Pullman and Caboose Radio

The Pioneer Work of the Lackawanna Railroad In Applying Radio to the Needs of Land Travel

By S. G. Roberts



EIGHT years—a short span in point of time but an age in radio development—have elapsed since this train, the Buffalo Limited, left Hoboken, justly proud of the fact that it was the first to be equipped for the reception and transmission of radio telegraph and radio telephone messages. That was in 1914, before the World War, and before the meteoric development of radio from an uncertain thing to a practical means of communication on a small as well as large scale. Little of an every-day, practical nature was accomplished at that time, for the technical side of radio was hardly toddling along with those who would put it to hard, every-day work. Yet, crude as it was, it did prove the need for this means of communication in modern railroading, and it remained for the radio men to develop radio under the stress of war to a point where the railroader would again take it up. This time radio is here to stay. It is practical. It is necessary. Mr. Roberts, in the accompanying article, tells us of the recent Lackawanna experiments, and, after a lapse of eight years, continues the story of the unrelenting efforts of this great Eastern road to apply radio to land travel. The day of Pullman and caboose radio is coming.—THE EDITOR.

"HE that runs may read" is no longer a phrase to arouse astonishment inasmuch as he that sits and rides may hear words and music from afar when speeding along the tracks at a rate of half a hundred miles and more an hour. Such is one of the things made possible by the evolution of the radio telephone, and this achievement is the present climax of experiments begun by the Delaware and Lackawanna Railroad back in 1909.

Sunday evening, April 30th just gone, two trains pulled out from the opposite terminals of the line, *i.e.*, Buffalo, New York, and Hoboken, New Jersey, and the buffet car of each of these trains was equipped with wireless apparatus for the reception and amplification of radio entertainment broadcasted from the different high-powered stations situated within transmitting distance of the route traversed. As a result of the experience gained then, it is the intention of this enterprising railroad to install upon its fast day trains de luxe, for the benefit of passengers, radio apparatus capable both of receiving and of broadcasting. The latter feature will enable travelers to talk from moving trains to subscribers of contiguous wire-telephone systems.

This radical departure in public convenience and pleasure may very properly be considered the immediate consequence of certain recent tests initiated by three youthful radio experts, Messrs. David W. Richardson, G. Donald Murray and Edgar G. Sisson, Jr., of Princeton University, in which the Lackawanna Railroad and its technicists collaborated generously. It may be recalled, however, that the Lackawanna Railroad, early in 1913, erected towers and established wireless telegraph stations at Scranton, Pa., and at Binghamton, N. Y.; and through these agencies it was found practicable to maintain communication between those points by radio quite as satisfactorily as by the long-instituted Morse circuits. Later, the road created kindred facilities at Hoboken, N. J.; and the three stations, in combination with train apparatus, subsequently proved invaluable in dispatching trains and in keeping up communication when storms wrecked the pole lines in New York, New Jersey, and Pennsylvania. The World War compelled a cessation of the radio service of the Lackawanna Railroad, but not before much had been learned by the engineers concerned.

After an interval of more than seven years, to be exact on March 22, 1922, experiments were resumed by the road with better and fuller equipment and utilizing recent developments in radio receiving apparatus. On the first run, a single car was fitted with a temporary one-wire antenna, pretty much like the arrangement employed originally for the reception and transmission of wireless telegraph messages. The trip was only as far as Morristown, N. J., and the plant was made up of a regenerative receiving set and a two-step amplifier. This outfit was sufficient to pick up the signals of amateur wireless telegraphers along the way; and the big broadcasting telephone station at Newark, N. J., WJZ, could be heard distinctly at a distance of about 25 miles. On the 24th of March, an antenna was placed on two 70-foot cars in the Hoboken yard. Then a 15-watt radio phone transmitter was tested, and with it it was feasible to broadcast from there for quite nine miles. Receiving proved to be astonishingly good, and many outlying stations were audible.

Still better results were obtained on March 26th, when a buffet car was fitted with a three-cage 6-wire antenna, using 4½-inch copper wire rings for forming and spacing. These antenna units were located about 15 inches above the roof, as follows: one on each side, and one in the center. Again, the 15-watt phone set was utilized in combination with a detector 2-step amplifier and a regenerative set. This car left Hoboken at 10:20 A. M. on the date mentioned; and the performances of the radio apparatus are thus described authoritatively: Underneath the iron superstructure of the Hoboken terminal, a few local amateurs were picked up, and one or two radio phones were audible on the loud speaker in the buffet car. As soon as the terminal was cleared there was a pronounced increase in signals, and as the Bergen Tunnel in Jersey City was neared many local amateur wireless telegraphers were "copied." Inside the Bergen Tunnel, which, by the way, is 4283 feet long and 90 feet under ground, one or two CW (continuous-wave) stations and several ships were heard distinctly. Upon emerging from the tunnel, the strength of signals was augmented abruptly.

The radio station aboard the Cornell Special, showing some of the equipment employed in broadcasting and receiving radio telegraph and radio telephone messages

While going through Newark in the Oranges, various tests on the transmitting set were carried out, but no effort was made to receive. Upon reaching Stroudsburg, Pa., a telegram awaited the train containing the information that the radiophone messages dispatched from the train had been picked up several times by people along the route who were listening in. From Stroudsburg, climbing up the Pocono Mountains, the receiving set was tried out, and local amateurs, distant ships, and 600-meter stations were heard. A little later, adjustments were made in the transmitter; steps were taken to protect the receiving set from the jarring action of the train; and an amplifier tube, which had a loose element in it, was replaced. These changes served to put the apparatus in excellent working condition. The transmitting set radiated .7 ampere into the antenna. One or two long signals on CW were given, followed by voice calls.

When about 10 miles away from Scranton, Station 8ARI, using 197-meter wave, was plainly heard calling by voice: "Hello, D.L.; hello, D.L.; hello, D.L.; hello, Lackawanna Limited. I am receiving your voice very clearly. Please come in and give me your location." The train was then descending the mountains at a speed of 63 miles an hour, traveling through ravines, cuts, and tunnels. There were hills on all sides, and conditions were hardly such as would favor radio work. However, communication was then established with 8ARI, and conversation was continued until the Limited arrived in Scranton. The signal strength of 8ARI, while the train was in Scranton, was such that people who gathered in the special car could hear everything that was said. During this test only a one-car antenna was used.

On leaving Scranton, bound back for New York, Mr. Richardson reports: "A message was sent to the Scranton *Times* from Mr. L. B. Foley, Superintendent of Telegraph, Telephone and Wireless of the Lackawanna Railroad, by way of Station 8BUW. When 8BUW was repeating the message for verification the Limited was passing through a tunnel, and it was interesting to note that the effect of this was scarcely noticeable, although the tunnel was several hundred feet long. Steady two-way telephone conversation was maintained until the train was about 12 miles distant from Scranton, when, on swinging around a mountain, 8BUW was lost and was not picked up again until the Limited had climbed to a large lake. While skirting this lake, there was a pronounced increase in signals, and Stations 8ADQ, 8BUW, and 8ACE were heard."

From the lake onward, the log of the trip reads as follows:

Time P. M.	Station	Remarks
5:15	2BRB	Just readable
5:20	1RX	QRK (I am receiving well)
5:25	2BK	QSA (Your signals are strong). Had been hearing him before but did not get call
5:35	1RX (again)	QSA
	We were now going about 60 miles an hour and were in the Poconos, some 30 or 40 miles from Scranton	
5:37	WJZ	Faint
5:38	1YZ (?)	Very faint
5:45	1ARY	Loudest station so far
5:46	3MT (?)	Very faint
5:47	2BM	QRK
5:48	2BY (?)	Not sure
6:00	1RX	Very QSA
	Now passing over plain and signals much stronger	
6:15	1CNI	QRK
6:20	1BQL	QRK
6:40	1GM	Very QSA
6:50	2ACY	QSA (Near Blairtown, N. J.)
7:05	2AHU	QSA
7:10	1ADL (CW)	Very QSA

Broadcasting radio telephone conversation from an experimental equipment recently tested on a train of the Lackawanna Railroad. The operators are Edgar G. Sisson, Jr., and G. Donald Murray

Telegrams awaiting the Special at Stroudsburg stated that voice transmission from the train had been heard for 20 miles out from Scranton, and that the CW position report of the Limited had been received at Scranton while the train was passing Elmhurst Dam, 10 miles away.

In summing up the results of this epoch-making run, one of the experts says: "In the way of an experiment, perhaps the most suggestive data gathered was that bearing upon the effect of location on the signals. Nearly all previous theories seemed to be confirmed, except that having to do with the immediate proximity of rock, steel bridges, and bodies of earth. But little difference in performance could be noted when the railroad ran through a steep cut, 30 or 40 feet deep, or when the line was on the level. However, when the train traversed a thickly wooded area, where the trees were high, all long distance signals faded out completely. The nearness of a body of water, even though small, seemed to greatly augment signal strength. The position of the antenna in relation to the station from which we were receiving was an important factor, for often, when going around a curve on a level stretch, the signals of one station would be silenced and those of another group would be brought in. The best signal strength was obtained when traveling upon a high embankment across a bare plain. The results then were even better than when in the proximity of a lake."

Profiting by the foregoing experience, the Lackawanna equipped a "Radio Limited," which was dispatched from Hoboken on the evening of April 4th, to bring back the next day from Ithaca, New York, for the Easter holidays, several hundred Cornell College students. To a point, history then repeated itself, for on the first of April, 1914, this railroad placed at the disposal of the 550 Cornell students a special train provided with wireless telegraph apparatus; and on that run from Ithaca to Hoboken the wireless operator transmitted 128 radiograms from the train to the fixed stations at Binghamton, Scranton, and Hoboken.

The principal elements of the telephone installation on the "Radio Limited" were put aboard a steel buffet car; and in the small baggage compartment of this vehicle were located the motor-generator and transmitting unit. As a precautionary measure, a spare set of car-lighting batteries was carried on the floor for emergency service. The motor of the transmitting unit operated on 12 volts, direct current, and the generator developed from 300 to 350 volts. The modulating elements were composed of three 5-watt power tubes, shunted with an ordinary high-resistance transmitter. The transmitter, mounted on a desk stand, was placed in the passenger compartment of the buffet car. Instead of the ordinary switch hook there was substituted a special push button, which controlled the motor circuit as well as the antenna switch. The resulting operation of the apparatus was much like that of the ordinary telephone during conversation. The wave-length control condensers were secured to a small panel, to which were also attached the usual voltmeter, modulating indicator, and antenna ammeter.

The antenna on the buffet car was like that previously described, and a similar antenna was stretched over the roof of a neighboring dining car. The purpose of this double arrangement was to insure maximum radiation while transmitting. For receiving, however, one antenna was sufficient, and no difference in audibility of signals was noticed when receiving on one or both of the antennæ. Radiation did not exceed .7 of an ampere. When the antennæ were coupled, the natural wave length was 275 meters.

Before the special left Hoboken, and while it was standing in the yard, tests with the loud speakers were far from satisfactory. Although the volume of sound was ample the quality or definition was not up to the mark, owing mainly to mechanical vibrations which affected the plates of the tubes. The use of the loud speakers would have been abandoned had not an improved type of magnavox amplifier been procured at the last moment. This instrument has two stages of power amplification, which makes it feasible to reduce audio amplification and thus to improve the quality of arriving signals and the reception of broadcasted entertainment.

The train pulled out from Hoboken at 7:20 P. M.,

One of the cars of the Cornell Special with the three-cage antenna carried above the roof

and while en route to Scranton, 140 miles away, all of the principal broadcasting stations east of Detroit were heard distinctly from end to end of the buffet car, using the while only one stage of the magnavox power amplification. When the Special stopped at stations, the music was of sufficient volume to be audible to people standing around within a considerable radius.

On the trip eastward from Ithaca, the distance of 272 miles was covered in seven hours, and high speeds had to be maintained when practicable to offset the climbs over three mountain ranges, varying in elevations from 900 to 2,000 feet. One can easily realize what must have been the thunderous rumblings of the train when hastening along at full tilt. However, by carefully adjusting the filament rheostats so as to utilize both stages of power amplification, neither the roar of the train nor the conversation and chatter of scores of students in the packed car in any way drowned the music, vocal or instrumental, arriving from distant broadcasting stations. Indeed, the received entertainment was heard plainly in the adjoining dining car. On three occasions, telephone conversations were carried on with enthusiasts from 6 to 14 miles away from the speeding train.

The students were not content merely to listen to the music emanating from outlying sources—they insisted upon returning the compliment. Mr. J. J. Graf, telegraph, telephone, and wireless engineer of the Lackawanna Railroad, tells this amusing story: "There were on board several members of the Cornell Jazz Orchestra, and they wanted to know if we could broadcast some of their popular selections. We thought we could. The horn of the magnavox was promptly converted into a collector, and a moment later the performance was on. The music was good and was heard distinctly by a number of persons who were listening in at Scranton, 40 miles away, while on reaching Stroudsburg we were told that this novel concert had afforded entertainment there during the whole time the train was descending the slope of the Pocono Mountains."

In conclusion, it may be of interest to mention that the Lackawanna Railroad intends, in the near future, to equip its freight trains with radio telephone service operable between locomotives and cabooses, and for this purpose the company will use a form of wired wireless employing "carrier currents." One of the great electrical companies has developed apparatus for this work; and communication by "carrier current" has emerged from the laboratory stage. Indeed, one Western railroad has shown what can be done by this radio system on trains traveling 60 miles an hour. The existing telegraph or telephone circuits along the roadway are made to direct and to radiate the wireless waves. Intercommunication telephonically by this means between the head and the rear of a train, especially a freight train, may obviate difficulties, speed up service, and be of considerable value in divers ways."

A return of the courtesies. Members of the Cornell Jazz Orchestra broadcasting music from the speeding special

Department of Commerce Radio Periodical

THE Department of Commerce, through the Bureau of Navigation, has for a number of years issued a monthly periodical called the "Radio Service Bulletin." This gives information regarding changes in the radio laws and regulations, additions, or changes in the list of licensed radio stations, and other traffic information, and also contains brief news items regarding new developments in radio communication, particularly in government radio work. Information is given regarding stations which broadcast weather and market reports, music, and other kinds of news and entertainment.

The Bureau of Standards contributes to the Radio Service Bulletin regularly items concerning its radio work and new publications in this field are promptly noted. A subscription to the Radio Service Bulletin, therefore, forms a convenient means of keeping in touch with the radio work of the Bureau of Standards as well as other government departments. In this connection, it may be borne in mind that because of the great number of demands upon it, the Bureau of Standards cannot undertake to send individual notices.

Subscriptions to the above-mentioned Bulletin should be sent to the Superintendent of Documents, Government Printing Office, Washington, D. C. The price per year is 25c for subscriptions in the United States, Canada, Cuba, and Mexico.

Our Point of View

The Great Reservoirs of the United States

IN no field of activity has the American engineer worked on a grander scale or with a greater breadth of vision than in the planning and erection of hydraulic works of the first magnitude. The great size of these works was not in the least determined by any vulgar striving after magnitude for its own sake. Considerations of utility and the urge of pressing public need were the impelling motives which led, for instance, to the erection in the Catskill Mountains of the Ashokan Dam, for the storage of 132 billion gallons of pure water, and the construction of 125 miles of aqueduct to lead this water into New York. It was the demand for greatly enlarged supply that determined the size of the 63-billion-gallon Wachusett Reservoir for the supply of Boston; and, as is shown elsewhere in this issue, the engineers of the city of San Francisco, foreseeing its future growth, are storing 113 billion gallons of water in the Yosemite region and building the aqueducts and pipe lines to convey this water, at the rate of 400,000,000 gallons per day, to that city and the surrounding district.

As a rule the municipal authorities of our largest cities have shown commendable foresight in the matter of water-supply planning, and have maintained the supply well ahead (as it always should be) of the immediate demand. In this respect water supply has fared far better than rapid transit; and the reason is not far to seek. Strap-hanging is more irritating than harmful. It is conceivable indeed that a subway patron of a philosophical frame of mind and extreme placidity of soul might persuade himself that the gentle art of strap-hanging, as a form of gymnastics, was conducive to physical well-being. In more senses than one the citizen who complains of inadequate transit facilities is told to go hang; but when it comes to the question of pure water supply our city politicians know that the citizens are face to face with a matter of life and death. When they ask for water, they get it, and get it in abundance.

Second in urgency to city water supply, but exceeding it in the magnitude of its hydraulic works, is the movement for the reclamation of arid lands, whose success stands and will forever stand, as a testimonial to the forethought and energy of Theodore Roosevelt. Great as are the reservoirs built for city water supply, they are modest in capacity when compared with the projects of the Reclamation Service. At the head of the list is Elephant Butte, New Mexico, with a storage capacity of 863 billion gallons. Roosevelt can store 425 billions; Pathfinder, 327 billions, and Jackson Lake, 254 billions. There are, altogether, a dozen reservoirs with a capacity exceeding 100 billions. Vast as these dams are they will be dwarfed when some of the proposed works for the regulation of the Colorado River have been constructed.

Do Tall Buildings Sway?

THERE is a popular impression that tall office buildings sway considerably in a gale of wind. That there is some movement is unquestionable, but it is very slight. It would be more correct to say that they bend rather than sway. All natural growths, from the blade of grass to the giant fir tree, bend under the pressure of the wind, for they are flexible or elastic, and under any side pressure due to the wind, they give way proportionately. The tall office building is also flexible, being built of steel that has high elasticity, and in a heavy wind, where the total side pressure may amount up to hundreds of tons, the steel framework will bend over before it. If the wind velocity never varied, if there were no gusts and the pressure for a given period of time never changed, the building would bend to leeward, to a certain extent, and remain stationary in that position so long as the wind pressure remained constant. Wind pressure is not constant but comes in gusts, and the building will be bent over in proportion to the strength of these gusts, moving to and fro, in accordance therewith. Occasionally this swaying is perceptible to the senses; but as a rule, in the most modern buildings, the movement is so very slight as to be imperceptible, except by instrumental measurement. Formerly, it was customary to allow for a uniform pressure per square foot over the whole surface from street level to cornice—30 pounds per square foot being the usual unit. Today it is recognized that the unit pressure increases with the height and calculations are made accordingly.

The Mississippi River Problem

ONCE more the turbulent Mississippi has broken through the artificial barriers which have been so laboriously raised in the endeavor to keep the river within its banks in times of flood. Although the floods are deplorable we must not fall into the error, as many people are sure to do, of pronouncing the present scheme of flood control to be a failure, and calling for an entirely different method of treatment The problem is one of vast dimensions, covering a great extent of territory, and the wise man is he who looks at it in a big, broad way, and avoids the error of condemning the whole scheme because of certain local disasters.

How big a problem this is may be judged from the fact that the drainage basin, that is to say, the lands, however remote, which contribute their quota to the waters which must ultimately find their way into the Gulf of Mexico, covers an area of 1,240,050 square miles. New York contributes its quota of flood waters; they come down from as far west as beyond Butte, Montana; and from Canada, where the catchment basin lies some 70 miles north of the boundary.

The Mississippi River Commission, which was formed in 1879, was called upon by the United States to formulate plans to deepen the river channel and protect its banks; to improve its navigation; and to put an end to destructive floods; and since that date the Commission has been steadily at work upon the problem, and has achieved results which are too little understood, and in any case are too readily forgotten when, as in the present year, excessively high spring floods cause the river in some places to get beyond control. The plan adopted is that of building levees to keep the river within its banks, and to make free use of dredges in the removal of sand bars and other obstructions.

It must not be supposed that the levee construction dates only from the formation of the Mississippi River Commission. On the contrary, we are informed by Mr. J. A. Ockerson, Consulting Engineer of the Commission, that construction of levees was begun at New Orleans as far back as 1717, and that by 1860 all the great delta basins had some measure of flood protection in detached lengths of levee. At that date they averaged about 4 feet in height; today the average height is about 18 feet.

A decided impetus was given to levee construction in 1850, when the Federal Government granted to the States along the Mississippi, all the unsold swamp and overflooded lands below the Ohio—this for the purpose of providing a fund for reclaiming inundated land. Nevertheless, whenever the river has broken loose controversy has arisen as to the best method of control, and, in general, it may be said that three different solutions of the problem have been proposed. Some believe that large reservoirs should be formed, temporarily to hold back the flood waters; others believe that artificial outlets should be made to by-pass the waters, and prevent them attaining a dangerous flood stage; and, lastly, there are those who believe that two centuries of experience with levees, and particularly the work of the Mississippi River Commission, have shown that complete protection will be attained when the levee system has been completed.

We have given considerable thought to this great question during the years that are past, and it has formed a subject of frequent discussion in our columns. The SCIENTIFIC AMERICAN is fully convinced that the only hope of controlling the Mississippi lies in following out the plans of the Commission with as much speed as the Federal Resources will permit.

Opponents of levee construction have claimed that as the height of the levees is raised the bed of the river automatically raises with them, leaving the problem in as bad shape as before; but careful surveys by the engineers have proved that there has been no progressive elevation of the bed of the river due to the levees. Indeed, we are told that a comparison of present cross sections, compared with those of an earlier day, proves that there is a well defined tendency to an enlargement of the cross section, and a lowering of the bed of the river.

The standard levees are built up to a height of 3 feet above the highest flood stage, and after completion they are sodded with grass as a protection against erosion by rain. Where they are exposed to wave action, a layer of concrete protection is used. Bank erosion is prevented by the use of revetment, which consists either of willow mattresses, or some form of concrete mats. The experience of the past 200 years, and especially the expert investigations and work of the engineers of the Commission, have solved the various problems of control, and the ultimate mastery of the great river, as we have said, is merely a question of provision by the Federal Government of the necessary funds.

Wrecking the United States Army

IN our last issue we showed how the House of Representatives was, in effect, wrecking the United States Navy. Not content with that, it is now attempting to wreck the United States Army. The Navy has been saved by the resolute action of the public, which, as soon as the facts were made public, called a halt upon the House proceedings

That the present action of the House would wreck the Army will be evident, if we give a brief resume of the action of Congress in this matter during the past two years. In the first place, let it be clearly understood that the War Department is not in favor of a large regular army, believing that such an army is not agreeable to our history or to our national temperament. This attitude was proved when a bill was introduced for the creation of an army of 500,000 men; for the measure was strongly opposed by Col. John M. Palmer who, in his testimony before the Senate Committee, made such a profound impression that they appointed him as their official adviser. As the result of his advice the law of June 4, 1920, was passed, calling for a regular army of 280,000 men, including 17,000 officers, a large portion of whom were to be used in training the National Guard and the Reserve, or Citizen Army. The army plan embodies the experience gained in the World War and it aims to preserve everything that can be saved out of that great effort. Instead of maintaining a large regular army of half a million men, the General Staff believes—

First, that far better results, at a less cost, can be obtained by maintaining a smaller regular army in a condition of perfect preparedness, which would act as the first line of defense in case of an invasion.

Second, that the officers of the regular army should be used to train the National Guard, maintaining the closest cooperation with that body.

Thirdly, that back of the first line of the regular army, and the second line of the National Guard, there should be an army of reserves, the officers of which should receive fifteen days training every year, by officers delegated for that purpose from the regular army.

The plan contemplates the division of the United States geographically into nine Corps Areas, in each of which there should be maintained a regular army division of 19,000 men, complete in every respect, with its supplies of war material located ready to hand.

In each area there would have been two National

Our Point of View

Guard regiments, recruited to the full quota of 320,000 men, and at stated intervals the National Guard would assemble for special training and maneuvers.

In each Corps Area, also, there would have been three reserve regiments, constituting the Citizen Army, and every year the Reserve officers were to be called up for fifteen days of training. With the officers of the Reserve thus held together and efficiently instructed, it would have been possible to assemble the Citizen Army in the respective Corps Area in which they live, without confusion and with a minimum loss of time.

Such was the plan worked out by the General Staff of the army, and embodied in the National Defense Act of June 4, 1920, which, as we have noted, called for 280,000 regulars and 17,000 officers. Congress, however, granted money sufficient for only 170,000 men, alleging that it did not believe it was possible to recruit a larger number. As a matter of fact, voluntary recruiting was so rapid that, early in the day, the army had secured 143,000. Nevertheless, the cut to 170,000 was made. The following year Congress, in June 1921, made a further cut to 150,000 men, with 13,000 officers. This number represented the absolute minimum with which it would be possible to carry out the excellent scheme for a first, second, and third line of defence, consisting respectively of the regular army, the National Guard, and the Reserve or Citizen Army. It should be noted here that two secretaries of war—one Democratic, the other Republican—had affirmed with great emphasis that 150,000 men was the minimum to which the army could be cut, without absolutely wrecking the plans of the War Department.

Nevertheless, in the present year the House of Representatives has made a further cut to 115,000 men and only 11,000 officers, and it has appropriated moneys sufficient to train only 1000 Reserve officers. The absurdity of this is shown in the fact that there are 60,000 Reserve officers who have offered their services under the new army scheme, and that at the rate laid down by Congress it would take 60 years to train this number.

That the country is entirely out of sympathy with the destructive policy of the House is shown by the widespread enthusiasm with which the National Guard and the organized Reserve have responded to the call of the Army.

Now with the minimum of 150,000 in place of maintaining a division of 19,000 men in each of the nine Corps Areas, with eighteen National Guard Divisions, and the nucleus of twenty-seven Citizen Army Divisions, it would have been possible to maintain in each area only a re-inforced brigade of regulars, with the National Guard and Reserve quotas cut down proportionately. It would be difficult to provide from this reduced army sufficient officers for National Guard and Reserve Army training purposes; but if Congress will grant an army of this strength, the General Staff is prepared to strain every nerve to secure all-round efficiency, on such a basis.

From the above it will be evident that the action of the House in cutting the Army below the absolute minimum of 150,000 will be absolutely destructive. Indeed, the General Staff affirms that there will be nothing for it but to forego the whole scheme and fall back upon the old system, which in all previous wars has found the United States in a condition of complete and very costly unpreparedness.

Potential Military Man Power of the British Empire

IT will be remembered that in our issue of December, 1921, we published an article on the leading armies of the world, showing the strength of the various active armies, their strength in trained reserves, and the total available man-power of military age. The table for available military man-power credited the United States with 15,700,000, Great Britain with 25,000,000, and France, Italy, Germany and Japan with from 5,000,000 to 6,500,000 men. Since the publication of that article we have been in receipt of correspondence calling in question the large figure of 25,000,000 military man-power credited to Great Britain, and in response to our application for the figures as estimated by competent authorities of the British War Office, we have received the data given below.

The total male, white, population of the British Empire is estimated at 30,000,000, and of these we are informed that 30 per cent, or about 9,000,000, are males of military age, fit for military duty.

It will be evident to anyone who read our article, that the high figure of 25,000,000 was due chiefly to a liberal estimate of the military man-power which would be derived from the teeming millions of India, and in the table which we gave it is stated in a footnote that in the estimate 5 per cent of the total population of India was estimated as being available. The War Office advises us, however, that as regards colored manpower, it considers that reliance cannot be placed on a larger figure than 3,000,000, as representing the number of colored males fit for use as fighting troops.

The numbers who might be regarded as man-power from the point of view of labor, or ancillary services, depend upon the exigencies of the moment. If the figure of 1,000,000 be taken as being the maximum requirement relative to the 9,000,000 white and 3,000,000 colored males, as mentioned above, this would give the grand total of man-power available as 13,000,000.

It must be remembered, moreover, that although the men of some of the tribes in India are noted for their stamina, courage, and amenability to discipline, and have proved their worth in various branches of the military service, the great mass of the Indian population has neither the physique nor other qualities that are necessary to the makeup of a soldier.

The Cluttered Dashboard

ONE of our British contemporaries is responsible for the suggestion that the ex-aviator is responsible for the extraordinary multiplication of instruments which is to be seen on comparison of the dash of a current automobile with a car of five or six years ago. We think the idea is a sound one, both as regards the origin of the practice and in its implication of the utter folly thereof.

Instruments on the dash are, of course, inevitable. Nobody wants to drive without a speedometer, an ammeter, and an oil gage. But why a clock? Why an assorted collection of dials that make the inner elevation of one's petroleum-buggy resemble the control board of a central power station, or an overcrowded pawnshop window? Why the present mad race for a multiplicity of nickelled protuberances in the cockpit of the road cruiser?

Perhaps the answer is to be found in a recent advertisement which considerably tickled our risibilities. The better part of an expensive page was devoted to picturing the supreme delight with which an owner might look upon the automatic cigar-lighter that exclusively features the advertiser's machine—how from his proud station in this car he might look down with amused contempt upon the unfortunate driver whose machine leaves him at the mercy of the match-box when he wants a smoke.

Now all sorts of reasons dictate the choice of a car. We know a man whose wife was of such extraordinary bulk that only one American car possessed a door that would admit her; but we have not seen the size of that door advertised on behalf of that car. We have no doubt that somewhere there exists a man who would buy the X Y Z car to get the cigar-lighter. But are there enough of him to advertise to? We have no doubt that some folk will prefer the car with fifteen knobs and dials to the one with only fourteen. But is not the general catering to this idea the result of a misdirected sales enterprise? Wouldn't our cars be more comfortable if they did not look quite so much like an instrument-maker's laboratory?

Close Relation Between Airbrake and Automatic Stop

IT needs no implication of words to prove that there is a most intimate relation between the airbrake and the automatic stop. For the one is a concomitant of the other. If there were no airbrakes, or if those carried on a train are inefficient, the automatic stop, and indeed the whole box system, might as well be regulated to the scrap heap. The determination of the length of the blocks and the spacing of the signals is based chiefly upon the weight and speed of trains, and upon the distances within which the brakes can stop a train of given weight, and running at a given speed.

That the Interstate Commerce Commission is fully alive to these facts is shown by its determination to ascertain, first, whether, and to what extent, the power-brakes and appliances now generally in use upon the locomotives and cars of railroads, that are subject to the Interstate Commerce Act, are adequate and in accordance with the requirements of safety; second, what improved appliances and devices are available for use; and further to determine what improvements in power brakes and appliances should be made, to the end that increased safety in train operation may be obtained. Hearings upon this matter have been had by the Commission, and it is the intention to carry through the investigation with great care and thoroughness. The railroads were ordered to furnish the Commission with certain specified information, and a perusal of the documents sent out to the railroads proves how searching this investigation will be.

In the first place, each railroad must furnish copies of its rules pertaining to the operation, inspection, testing, and maintenance of its brake equipment; and must show where facilities are provided for this, and give a list of locations where tests of pressure-retaining valves are made, together with a description of such tests.

A statement is called for, also, showing the location, length, and gradient, of all grades more than one mile in length, and having a maximum gradient of one per cent or more; the method of manipulating brake equipment on such grades must be described; the types of equipment and brake pipe and the main reservoir pressures; the limit and number of cars allowed on these grades, and the specified speed limits.

There must be furnished also a list of accidents on these grades, which occurred between 1919 and 1921, inclusive, where such accidents resulted from failure properly to control the speed of trains on these grades, together with full particulars of the losses of life, and the injuries to persons and property.

A statement is also called for, in detail, as to what extent hand-brakes are used for controlling the speed of trains, and showing also what power-brake equipment other than the airbrake is used, and to what extent.

The next requirement should yield a large amount of important and greatly needed data, for the railroads are required to give the number of accidents which occurred during 1921, and resulted in personal injury or loss of life from burst or parted air-hose; emergency application of airbrakes; undesired quick action of brakes; parting of the train; faulty manipulation of the brakes; and, lastly, accidental interference with proper operation.

In our opinion this is one of the most important investigations that has ever been carried out by the Interstate Commerce Commission; for it is certain that although the development of the airbrake has been one of the outstanding achievements in American railroad operation, there is yet some distance to travel before the ideal conditions have been reached. We repeat that a perfect airbrake is essential if we are to realize the full benefits of a perfect traffic-block signal system, equipped with the automatic stop.

Gyro-Stabilizer as Cure for Seasickness

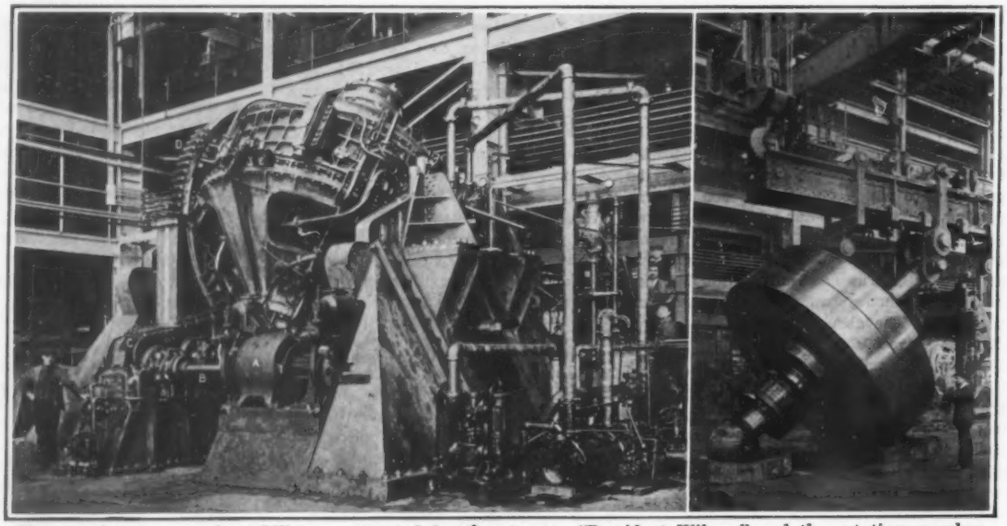
IF only some means can be devised to prevent, or, at least, mitigate the horrors of seasickness, deep sea travel, for the majority of people, will be robbed of a positive terror, and thousands of people who never cross the sea for fear of seasickness, will become frequent, if not enthusiastic voyagers.

Never will it be possible to steady a ship to the point at which all movement save that of progression will be eliminated; but thanks to patience, ingenuity, and technical skill, it has now become possible practically to damp out that abominable sidewise, rocking motion, known as rolling, which is the most common, and to many people the most formidable source of seasickness.

Many have been the devices with which the inventor has tried to prevent rolling. Thornycroft thought he could do it with a heavy pendulum; and then Frahm tried to do the same thing with what he called "anti-rolling tanks"—large water containers, one on each side of the ship, joined by a pipe or conduit, the flow of water from side to side being controlled by valves. And we must not forget Bessimer, who, half a century ago, built a large saloon, containing living and dining quarters, which he suspended within the hull of his vessel upon trunions, whose axes ran fore and aft. By means of hydraulic controls, he sought to anticipate the rolling, and maintain his suspended saloon upon an even keel. All of these were failures, although some slight success was attained with the rolling tanks.

Then came Elmer Sperry with his Gyroscope. Mr. Sperry had already gyroed pretty well everything on earth that called for controlled movement, and after giving to the world, through his compass, a means of steering an absolutely true course, he conceived the idea of using his gyro to prevent the rolling of ships—and succeeded.

Our illustration shows the latest and largest gyro stabilizer, built by the Westinghouse people for Mr. Sperry who has installed it on one of the Shipping Board vessels, formerly known as the "Hawk Eye State," and now renamed the "President Wilson." The "President Wilson" is to be placed in the trans-Atlantic service, and, if she performs as she is expected to do, she will achieve an instant popularity with the part of the seagoing public that is subject more or less to sickness, which by the way means a large majority.



The complete gyroscopic stabilizer constructed for the steamer "President Wilson," and the rotating member of the stabilizer before the assembly

The steadying action of the gyro is due to the fact that a balanced wheel, spinning at high velocity, strongly resists any outside force which tends to change the plane of its rotation. A peculiar fact regarding the gyro, which puzzled the early investigators until the mathematicians and physicists showed the meaning thereof, is this—that if you apply a force tending to tip a rotating gyroscope, it resists strongly in a plane at right angles to that in which the distributing force is applied; that is to say, if the gyro wheel is spinning in a horizontal plane, and a force is applied tending to tip it in a north and south direction, it will resist strongly in an east and west direction.

With this fact in mind let us see how the gyro steadies a ship against rolling. On the bottom of the ship, near its center, the gyro is carried in journals whose axis is transverse to the longitudinal axis of the ship, the whole mechanism being free to rock or tip in a fore and aft direction. Our illustration shows the gyro for the "President Wilson" erected in the shops and under test. What we see is the outer frame or casing, and within this casing, is the gyroscopic wheel, which in this case weighs 100 tons. The wheel runs in vacuo, the air being exhausted from the chamber in which it is enclosed. The speed of rotation is 800 revolutions per minute.

Now, if through suitable mechanism the spinning gyro is tipped out of the vertical, there is set up a strong resistance to this movement, the resistance being at right angles to the direction in which the force is applied. In this case the tipping is done by means of the electric motor *A* seen in front of the gyro, and to the right, whose drive-shaft *B* operates a set of gears housed in a casing *C* seen to the left of the gyro. These gears mesh with a large circular gudgeon *D* which is attached to the gyro casing *E*.

A complete gyro-stabilizer equipment calls for the following elements: First there is a steam turbine, which drives both an alternating and direct current generator. The A. C. is led to a motor which drives the vertical shaft of the big gyro-wheel. This wheel is run at 800 revolutions per minute in vacuo. The D. C. is led to a diminutive control-gyro, which in turn serves to operate the precession motor for tipping or precessing the main gyro. The control-gyro is so sensitive that it will indicate the ship's roll a fraction of a second after the roll commences. This indication is transmitted electrically to control panels, which operate the precession motor. The motor shaft, through a series of gears, serves to tip the main gyro in a plane parallel with the keel of the ship, thereby setting up a strong resisting force athwartship, which opposes the thrust of the waves tending to start the ship rolling. The result is that full stabilization forces are at work about 1½ seconds after the ship begins to roll, and in the case of the "President Wilson," the rolling will be restrained to a maximum of from two to three degrees on each side of the vertical.

Compare this with a roll of from 25 to 45 degrees, which obtains under unfavorable conditions on certain types of ship.

If the reader of this should begin to wonder how a ship of 20,000 tons, tending to roll 20 to 30 degrees, can be straightened out by a gyro outfit, which weighs only one per cent of the ship's weight, and how this can be done without producing severe local strains in the hull of the ship, it must be remembered that ship rolling is a progressive action. The first wave throws the ship over a little, the next a little more, the action being cumulative, until the full angle of roll for those particular conditions is reached. Now the gyro-stabilizer resists this tendency at the very outset, and resists the initial thrust of the waves. It does this so effectively that each impulse is damped out as it acts on the ship, and there is no cumulative action.

Mention should be made of the interesting fact that so large is the energy of the 100-ton spinning wheel, so perfect are its bearings, and so complete is the vacuum in which it rotates, that after the power has been shut off the wheel will run for four hours before coming to a stop.

The Hottest Place in the World

TEN years of record obtained at the United States Weather Bureau's substation at Greenland Ranch, in Death Valley, Calif., indicate that this is the hottest region in the United States, and, so far as extreme maximum temperatures are concerned, the hottest known region on earth. The temperature of 134° F., recorded in July 10, 1913, is believed by meteorologists to be the highest natural air temperature ever recorded with a tested standard thermometer exposed in the shade under approved conditions. High temperatures are common throughout the year, but the highest occur during midsummer. Precipitation is extremely light, the normal annual precipitation being less than 2 inches. Evaporation is excessive, as the relative humidity is extremely low most of the time, and especially during the hot spells of summer. White people find the midsummer heat most trying; even the Indians go up to the Panamint Range during July and August. The weather station maintained at Greenland Ranch in cooperation with the borax company is unique in many ways.

The Psychology of Stuttering

STUTTERING, with which we include stammering, is the most serious of the group of functional speech disorders. It is present in about 1 per cent of the school population. This disorder should be considered as symptomatic only. The underlying trouble may be neurotic, psychoneurotic, or some as yet obscure trouble in the control or coordination of the elaborate mechanism of speech.

We feel that there is some lack of balance in the motor control of all these cases, but the most important thing is the temperamental lack of ability to make the necessary emotional adjustments to life and the use of speech as a symbol of all the human relationships. In other words, the fear from which the stutterer suffers is not a fear of speech, but a fear of meeting situations in life, and speech is the accepted field for such a symbolization because poor speech closes the necessary avenue of approach to life and offers an excuse for failure that would otherwise be lacking.

It is maintained by some workers in the field that the mental condition and the emotional conditions are the result of, and not the cause of, stuttering. It would be true, of course, that the difficulty would carry with it a large amount of unpleasant emotional tone, but it is a significant fact that the families of these people show the same temperaments, the same social disabilities, to a somewhat greater extent than do the families of non-handicapped children.

Teachers who do the speech-corrective work should have, besides a knowledge of the physiology of the organs of speech, a knowledge of speech drill and a thorough training in behavioristic psychology and the psychology of the emotions. They should know the part speech plays in the development of the emotions, and how poorly controlled emotions may develop wrong types of speech. Moreover, they must be trained to understand some of the mental mechanisms that control behavior, such as feelings of inferiority and its compensations in over-boldness and over-talkativeness, and be able to analyze and treat these conditions. Teachers so trained can do mental-hygiene work of the highest type, for they deal with children who have great possibilities.

An Unsinkable Power-Driven Lifeboat

WHAT may safely lay claim to being the largest lifeboat in the world, measuring 60 feet long and having a displacement of 40 tons, is now being built by the Royal National Lifeboat Institution of Great Britain, at a cost of about $85,000. This boat is to be stationed at New Brighton, near Liverpool, and will be quite capable of offering help to vessels far beyond the reach of existing boats, since her radius of action will be 100 miles at 10 knots. On this long journey this huge lifeboat will accommodate 50 out of her 150 passengers in the two cabins, where they can find warmth and shelter and cooking facilities.

The novelties of this lifeboat, which is shown in detail in the accompanying full page illustration, include a net, 11 feet square, amidships, into which the rescued will jump if the doomed vessel stands high out of the water; a line-throwing gun; an electric searchlight; winch and capstan driven by compressed air; three isolated engine rooms, two for the 75-horsepower motors driving the twin screws and one for the auxiliary engine driving the dynamo, pump and air compressor. This huge life boat has eleven traverse watertight compartments, and 100 buoyancy air boxes resembling in miniature the water tight compartments of a battle cruiser. These make her practically unsinkable. She will lie at moorings, and not housed ashore.

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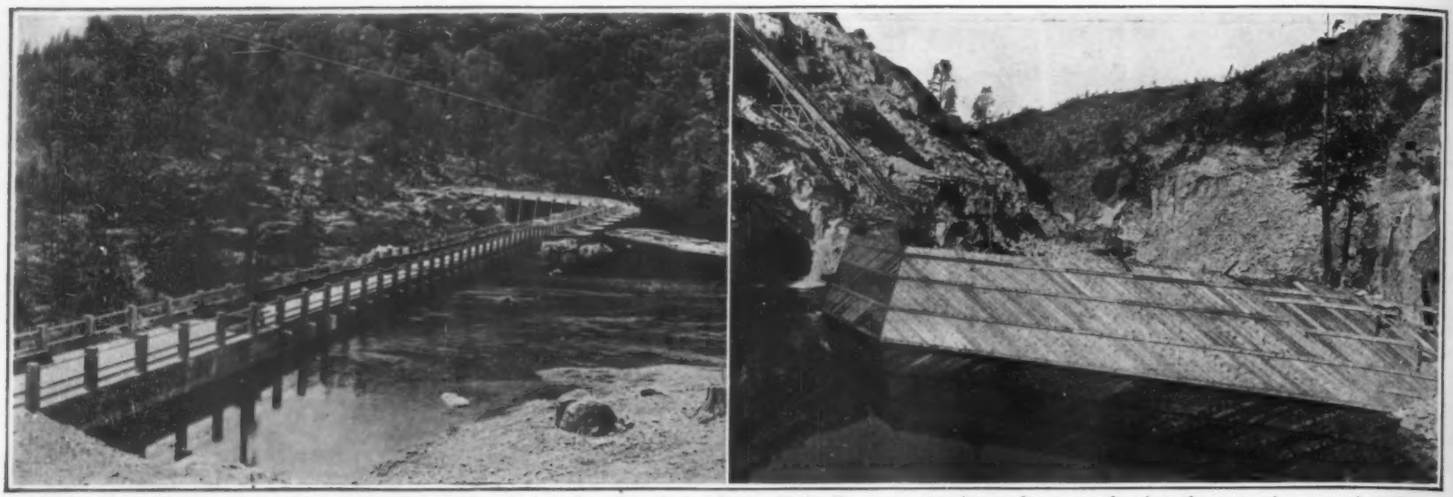
THE LARGE UNSINKABLE, POWER-DRIVEN LIFEBOAT ABOUT TO BE EMPLOYED IN GREAT BRITAIN FOR RESCUES FAR OUT AT SEA

(See facing page for details)



Left: **The Lake Eleanor Dam, which measures 1260 feet in length and is 70 feet high.** *Right:* **Dam construction under way, showing the extensive use of timber**

San Francisco's Water Supply Project

Bringing 400,000,000 Gallons Daily by Tunnels and Pipe Lines from Yosemite to San Francisco

By M. M. O'Shaughnessy, Member A. S. C. E., City Engineer of San Francisco

SAN FRANCISCO is engaged in the construction of a municipal water supply system, known as the Hetch Hetchy Water Supply project, of greater magnitude than any similar system in the United States, with the exception of those of New York and Boston. It will make available to San Francisco and the adjacent metropolitan area 400,000,000 gallons daily of pure mountain water, and this same water, passing through huge water wheels installed in electric power plants, will generate 200,000 horsepower of hydro-electricity for general use in Central California. Power and water are two great essentials in the development of the industrial and agricultural regions tributary to San Francisco.

The Tuolumne River and some of its tributaries in the Sierra Nevada, over 150 miles from San Francisco, are the sources of the city's future water supply. The project takes its name from the principal reservoir site, Hetch Hetchy Valley. The Spring Valley Water Company has been supplying water to San Francisco since 1860, from local sources owned or controlled by this corporation. But this supply is fast becoming inadequate for the rapid growth of San Francisco. Long ago it was foreseen that the city must at some time bring in a supply of water from some source more distant and more productive, though acquiring and retaining the local works of the Spring Valley Water Company, which would gradually assume the position of an auxiliary. Most of the main streams of northern and central California have at various times been studied as possible sources of the additional supply.

In 1908 a permit was granted by Secretary of the Interior Garfield, for the use of storage reservoir sites located on public lands within the boundaries of the Yosemite National Park, and applying to lands and waters tributary to the Tuolumne River in the northern part of the park, 20 miles distant from the Yosemite Valley, which is drained by the Merced River and is in no way affected by the city's plans. The people of San Francisco straightway set the seal of their approval upon the project by voting, almost unanimously, a $600,000 bond issue for the purchase of privately owned lands and water rights, and later, in 1910, an issue of $45,000,000 bonds to finance construction.

It was at first intended that the Hetch Hetchy system should supply only San Francisco; but the ultimate capacity fixed for the Hetch Hetchy works, 400,000,000 gallons daily, takes into reckoning the requirements of the locality west, east and south of San Francisco Bay, throughout the present century. The engineers have treated this region as a metropolitan water district, all units of which have a common interest in obtaining additional water.

To take care of the immediate future a 23 mile section of the aqueduct is to be built near San Francisco, between Alameda Creek and the Crystal Springs reservoir of the Spring Valley system, to make available the water to be obtained from the final development of the local sources. Later on, it will carry Hetch Hetchy water.

In the Sierra Nevada Mountains, between Early Intake and Moccasin Creek, 134 miles from San Francisco, the Hetch Hetchy aqueduct is being completed. The building of the remaining portions of the aqueduct is to follow in time to have Hetch Hetchy water ready for delivery when the community has absorbed the additional water supplied from the Spring Valley sources.

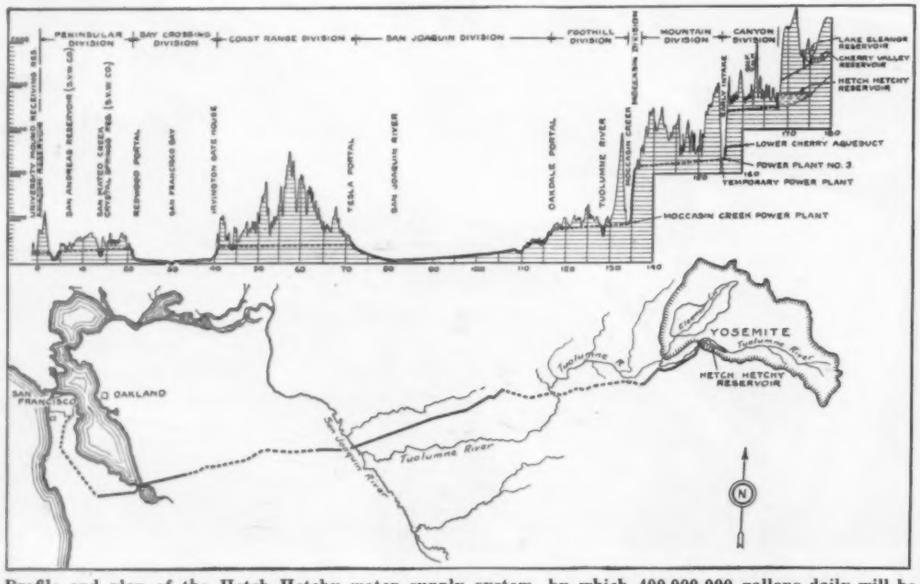
The Hetch Hetchy dam is being constructed now to about three-fourths of its ultimate height. This will develop about 60 per cent of the final reservoir capacity. The Moccasin Creek power plant is to be built. It is estimated that by the end of 1923 this power plant will be in regular operation. Other units of the Hetch Hetchy project will be built as the demands for water and power increase.

The high mountain watershed area of 652 square miles, from which the City's proposed impounding reservoirs will be filled, ranges in elevation from 3500 feet at Hetch Hetchy dam to 13,090 feet at Mount Lyell. Within Yosemite National Park lie the Hetch Hetchy and Lake Eleanor watersheds, 459 and 79 square miles respectively. By means of a diversion tunnel and canal, Cherry Creek is to be made tributary to Lake Eleanor. Its watershed lies in the Stanislaus National Forest, and covers 114 square miles.

Now the Hetch Hetchy reservoir will have a total capacity, with a 300 foot depth at the dam, of 113,500,000,000 gallons, or 348,000 acre feet. But in the initial development the depth at the dam will be only 220 feet, storing 67,000,000,000 gallons, or 206,000 acre feet. The elevation of this reservoir at the original stream level is 3500 feet. At Lake Eleanor the ultimate capacity has been tentatively fixed at 54,000,000,000 gallons, or 166,000 acre feet. A storage of 27,000 acre feet, at elevation 4600 feet, has already been developed in connection with the construction power plant to be mentioned later.

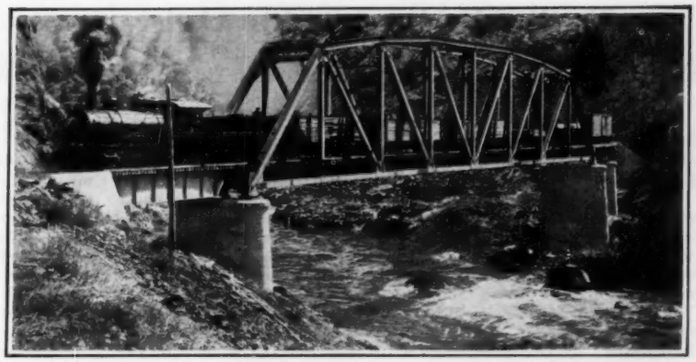
The water released from Hetch Hetchy reservoir is to flow 12 miles down the Tuolumne River to Early Intake, where there will be a diversion dam to turn the water into the section of the aqueduct now under construction. Later, by means of a tunnel aqueduct in the granite canyon wall on the south side of the Tuolumne River, the fall of 1200 feet in this twelve miles of the river will be made use of for power development, creating about 42,000 kilowatts. To utilize the Lake Eleanor water, an 8-mile aqueduct of 200 second-feet capacity is to be built, leading from Lake Eleanor to a power drop at which a head of 2100 feet will be available. The water will be discharged into the Tuolumne River above the Early Intake diversion. This power unit will be capable of generating another unit of about 25,000 kilowatts.

The beginning of the aqueduct now under construction is at Early Intake, from which point 18.3 miles of tunnel operating under light pressure, will conduct the water to the Priest regulating forebay reservoir. The



Profile and plan of the Hetch Hetchy water supply system, by which 400,000,000 gallons daily will be brought from the Yosemite to San Francisco and adjacent districts

water will be received by the Priest reservoir at the constant rate of flow of 400,000,000 gallons daily (620 cubic feet per second), and discharged under 1300 foot head at the varying rates required by the fluctuating load conditions at the Moccasin Creek power plant. It will be formed by an earth and rock fill dam 145 feet in height, with concrete core wall. The capacity will be 2500 acre feet, or two days' flow of the aqueduct. An outlet tunnel 1.3 miles in length will lead from this reservoir through a ridge to the head of the steel pressure pipe lines, each 4,700 feet long, that will supply the 70,000 horsepower hydro-electric plant on Moccasin Creek.



The Hetch Hetchy Railroad, 68 miles long and costing $2,000,000, built for construction purposes, will be maintained permanently. Span of above bridge is 220 feet

The present Spring Valley supply will be connected with water from the Hetch Hetchy system by means of an aqueduct running west from Moccasin Creek to Crystal Springs. Its start will be at the tail race reservoir from Moccasin Creek power plant at elevation 900 feet. The discharged water from the plant will be received by the reservoir, and its flow regulated to a constant rate for transmission through the aqueduct. Here tunneling is resumed, extending about 17 miles to Oakdale Portal, in the foothills east of the San Joaquin Valley. The tunnels heretofore mentioned are designed for a flow of 400,000,000 gallons daily.

From Oakdale Portal to Tesla Portal, the great central San Joaquin Valley will be traversed by large steel pipes extending 45.2 miles. The capacity of the first of these lines is dependent upon the development of the metropolitan district plan—not less than 60,000,000 gallons daily, in all probability. Ultimately the project will require three lines, each one nearly seven feet in diameter, and each carrying 133,000,000 gallons daily. These pipes will be subjected to heads of from 450 to 540 feet for 70 per cent of their total length. Such long lines of pipe under high heads are unprecedented in municipal water projects.

West from Tesla Portal tunneling is resumed to penetrate the Coast Range, a distance of 31 miles, to the Irvington Gate House, a few miles east of San Francisco Bay. This will be the distribution point from which the water will be apportioned to serve the three main divisions of the Metropolitan District. The principal branch will go westerly to the San Francisco peninsula; the second will extend northwesterly to the East Bay cities; and the third, southwesterly to San Jose. A few miles east of Irvington Gate House, at the crossing of Alameda Creek, the waters of the nearby Calaveras reservoir of the Spring Valley system will be taken into the Hetch Hetchy aqueduct.

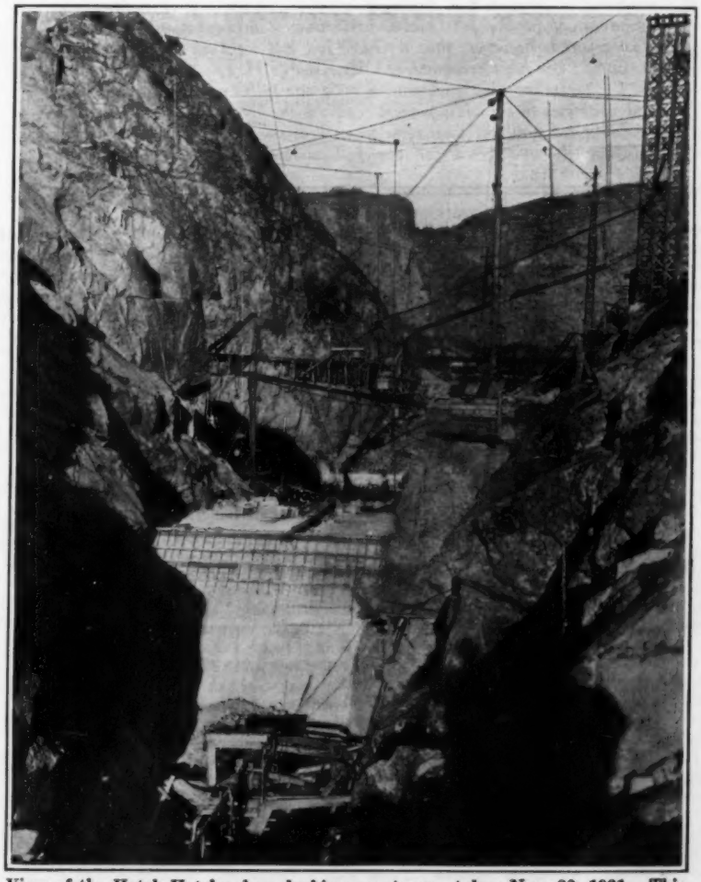
An ultimate capacity of 200,000,000 gallons daily is to be provided to supply the San Francisco peninsula. Proceeding westerly from Irvington, over 19 miles of pipe line is needed to cross the low land adjacent to San Francisco Bay and regain high ground on the peninsula west of the Bay. The initial line will first be used to carry the additional supply from the Spring Valley sources, and will probably have a capacity of 45,000,000 gallons daily. The head on the pipe will range from 300 to 365 feet for 17 miles of its length. Where it crosses the navigable channel of the Bay, in the initial stage, submerged pipe with ball and socket joints will no doubt be used—the same type as the line which connects Brooklyn and Staten Island. Ultimately this connection will require three parallel pipe lines, each over six feet in diameter. The termination of the division is at a tunnel portal near Redwood City.

Near Redwood City, a connection will be made from the tunnel to the Crystal Springs reservoir of the Spring Valley system, so that Hetch Hetchy water can be stored in that reservoir, the capacity of which is 22,000,000,000 gallons. From Redwood Portal to the receiving reservoir in San Francisco, a distance of 22 miles, the aqueduct is planned as a ten foot tunnel, broken at two places by siphons totaling two miles. The aqueduct will terminate in San Francisco at a reservoir which is to have a capacity of about 300,000,000 gallons. From this elevation about half of the supply can be distributed without pumping. Delivery by gravity at a higher elevation would unduly increase the cost of the aqueduct and would prevent using the Crystal Springs reservoir in connection with the Hetch Hetchy supply.

The plans provide for connections to unite the Hetch Hetchy and the Spring Valley systems, as it is the settled policy of the City Government to acquire all the properties of the Spring Valley Water Company which are of permanent value for water supply purposes. The combination of the two systems will afford a large capacity for storing both the mountain water and the local water in nearby reservoirs.

All of the Hetch Hetchy Water Supply work is under jurisdiction of the Department of Public Works of San Francisco, and the City Engineer is Chief Engineer of the project. At the town of Groveland, 27 miles on the city's railroad from Hetch Hetchy Junction and 41 miles from Hetch Hetchy Valley, the general headquarters of the construction work in the mountains are located.

The principal achievements on the project thus far include: Purchase of reservoir lands, water rights, rights of way for the Hetch Hetchy Railroad and for the main aqueduct in the Sierra Nevada, and lands for the Groveland headquarters and Moccasin Creek power plant. Construction of the 68 mile standard gage Hetch Hetchy Railroad and purchase of rolling stock. Construction of the Lower Cherry power system, including 3½ mile aqueduct, 3000 Kva. power plant and 33½ miles of transmission lines. Ten miles of main aqueduct tunnels have been excavated; the Hetch Hetchy dam is two-thirds completed. There are 1700 men employed on the construction work of the entire project, and expenditures to the present time total about $18,000,000.



View of the Hetch Hetchy dam, looking up stream, taken Nov. 20, 1921. This shows the downstream face. Depth of water in reservoir at dam, 300 feet; capacity 113,500,000,000 gallons

The Significance of Calcium for Higher Green Plants

IN a Vice-Presidential address delivered at Toronto in December, 1921, Dr. Rodney H. True of the University of Pennsylvania, discussed most interestingly the significance of calcium for higher green plants. Cell wall and the plasmal membranes that secrete it, Dr. True said, stand in the closest relation. Cell walls, except in specialized locations, are seldom decisive in determining what ions pass through them, through the chemical changes which take place in the walls themselves and thus far may be regarded as having a certain quasi-determining influence. Beyond that, after chemical demands in the walls have been satisfied, more deeply lying equilibria are concerned. As an ion-containing structure, the cell wall maintains ion-equilibria subject to the laws of equilibria in colloids, with the living membranes with which it stands in most intimate chemical and biological contact. When ion equilibria in the wall are disturbed, this disturbance is transmitted to the equilibria of the protoplast that lays it down, modifies it and remains in closest relation to it. Hence it is not surprising that a drastic change in the very chemical composition of parts of the wall itself if continued should work through and perhaps profoundly affect the equilibria of the protoplasm.

In conclusion, the author refers to the more practical results that seem to flow from the considerations thus indicated.

It appears that a certain quantity of Ca ions must be present in the medium for the maintenance of the chemical and functional integrity of the cell wall, as well as the chemical and functional integrity of the deeper lying living parts of the cells of absorbing roots or higher green plants. When this is so maintained, absorption takes place in the manner we are accustomed to call normal. When this necessary minimal supply of Ca ions in the medium is lacking, be it in soil solution, water culture, or sand culture, the function of absorption is upset and a more or less marked leaching of ions from the plant follows. In the absence of this necessary minimum of Ca ions, the soil solution or culture solution may be rich in all other required ions, but these are useless to the plant. They are unabsorbable. This brings us face to face with a condition of affairs in plant nutrition that has not been recognized and therefore has not been characterized. We may fairly say that Ca ions make *physiologically available* other equally indispensable nutrient ions. The practical consequences that follow from this way of looking at the fertilizer problem have not thus far been realized. We learn why from earliest times civilizations have grown up on soils rich in limestone débris. We learn why agriculture has readily succeeded in some regions, not in others. We understand why, by the use of lime, lands have been rendered capable of supporting largely increased populations. We are now able to correlate these broad facts with those of cell physiology and to suggest how higher green plants find calcium necessary.

Demountable Rim Installation

WHEN installing a demountable rim on a wheel, be sure that the bead of the rim is just flush with the edge of the felloe all the way around. If the bead and felloe are not even the wheel will have the appearance of wabbling. The lugs should always be drawn up evenly by giving each nut a few turns at a time. Do not tighten one lug before drawing up on the other.

Radio Rules in the Making

Congress Considering the Recommendations of the Radio Conference and in Modified Form Will Mold Them Into a New Law

By George H. Dacy

RADIO fans, the country over, who for many weeks have been scanning the newspapers looking for information about the new laws of the ether and radio art, may think that the national radio experts of our Federal legislators are taking their own sweet time in the consideration and passage of the new radio rules. The old saw about "Rome not being built in a day," pretty well applies to the consideration and formulation of the twentieth century radio legislation. The members of the radio conference, the most famous meeting of its kind in the history of radio, have made haste slowly in their surveys and studies of the needs of industry. They have carefully considered and weighed in the balance each detail and each issue. The best brains and knowledge of the radio art have been occupied for several months now in investigating the fundamental needs of legal changes in the Federal laws which pertain to wireless telephony and telegraphy. Now all this minute consideration and detailed discussion by the experts will result in the consummation of a radio law which will be letterperfect and still flexible enough to dovetail with the rapid potential development of the industry.

As has been previously noted at length in the May and June issues of SCIENTIFIC AMERICAN the American Radio Conference initially met at Washington under the chairmanship of Secretary of Commerce Herbert Hoover during the period from February 27 to March 2. At the end of this session, a tentative report was prepared and sent to all persons who requested it and to the representatives of the various interests which in the judgment of the Department of Commerce were interested. Subsequently, a large number of comments and suggestions were received from all parts of the country. On April 17, 18, and 19, the Radio Conference as a whole held additional meetings, the special technical committee having held daily meetings in the interim.

At these April sessions of the Conference all the comments and suggestions were considered, the general effect of these approbations or criticisms being to approve with a few trifling exceptions the substance of the preliminary report. Thereupon, the report was finally amended and adopted. In addition to preparing a report on technical matters, the Conference made recommendations as to essential points required in legislation to give the Secretary of Commerce authority necessary to accomplish the ends recommended through the power to make and enforce regulations. In the main, these recommendations were presented in the June issue of SCIENTIFIC AMERICAN. Additional agreements were reached which provided that the operation of the Government radio stations be conducted in such a manner as not to interfere with the commercial traffic and broadcasting, and that whenever Government-owned stations are used for the transmission of commercial traffic and broadcasting, they shall conform to the regulations established by the Secretary of Commerce. It was also agreed to add a provision for the appointment by the President of an Advisory Committee to the Secretary of Commerce, to consist of not more that twelve members, half of whom shall be selected from the Government service and agencies and the other half from commercial circles outside the Government service.

At the time when this article was written, the recommendations of the Radio Conference had not been prepared into bill form and introduced into the House of Representatives as pending legislation. It so happens that Representative Wallace H. White, Jr., of Maine, one of the prominent members of the Radio Conference and selected by that body to draft the recommendations into bill form and introduce them into Congress, has been so busy with committee meetings and hearings on the Merchant Marine legislation appropriation that he has been unable as yet to draw up the radio rules and launch the proposed legislation into Congress for discussion and ratification or rejection. Recently, the writer talked at length with Mr. White about the make-up of the new bill which will be in the hands of Congress at the latest by the third week in May. The information and data which follow come directly from Congressman White, who will act as father and chaperon to our new radio rules during their sojurn in Congressional circles.

The proposed radio legislation is emergent in character. The bill as it will be introduced will not be a comprehensive radio law. It will alter the former radio act passed in 1912 only in those respects where it is now obsolete as a result of the expansion and development of the radio industry. Only the essentially vital points which must necessarily be altered will be changed. At this time, it is not considered advisable by the radio experts to cover the entire field of the industry as this would involve too great delay. The factor that is most urgent is the satisfactory and permanent elimination as far as possible of interference in the ether, and it is thought that this can be accomplished so far as legal requirements are concerned by a comparatively simple bill.

The substantial and outstanding features of the proposed bill will consist of a re-drafting of sections 1, 2 and 3 of the present law which was ratified a decade ago. It is anticipated that these alterations will clarify and reinforce the existing law by enlarging the essential regulatory powers to the extent deemed necessary. In its present tentative forms, the bill provides that radio apparatus shall not be used as a means of intercourse between the several States or with foreign nations or for the transmission of signals, the effects of which extend beyond the State in which the signals are made, except under a special license granted by the Secretary of Commerce. This applies, it will be observed, only to transmitting stations and in no wise effects receiving stations.

By authority of the proposed legislation, the Secretary of Commerce is empowered to classify radio stations and the operators thereof; to prescribe the nature of the class of service to be rendered by each type of station; to assign bands of wave lengths; to make regulations concerning the class of service to be rendered by each class of station; to be the court of last appeal regarding the location of each station; to dictate the wave lengths and the kind of instruments to be used with regard to the external effect produced by them—the power, parity and sharpness of the waves, the times and methods of operating the stations. Briefly, the Secretary of Commerce is given blanket authority to establish such emergency regulations as—from time to time—are needed and, at all times, to act as he considers advisable for the protection and best interests of the industry.

The opinions of Representative White and the radio experts were that right now the industry is in a state of flux. They think it would be unwise under such conditions to write into the law hard and fast rules and other detailed provisions which are liable to require revision only a few days or weeks after enactment as measured by the present rapid development of the radio art. It is a hard enough matter to guide legislation successfully through Congress, but it is a still slower and more laborious task to alter and amend the laws once they are passed. If very stringent and precise regulations were established at this time, it might be that 24 hours after the new rules were ratified some untoward condition might develop which would render them a handicap rather than a help. The consensus of opinion of the Radio Conference was that such conditions could only be met satisfactorily by granting very general regulatory powers to the Secretary of Commerce. In this way the rules can be made as flexible as the art itself. Changes can be made as frequently as the vital occasion for such alterations arises. The opinion prevails that such authority will fortify and equip the Secretary of Commerce so that he can put into effect the detailed recommendations of the first national Radio Conference.

The proposed radio law will make certain and definite what is now doubtful—that it is not mandatory upon the Secretary of Commerce to issue a license to any applicant, but that this granting of licenses will rest solely in his sound discretion. Under the existing law, there is a doubt as to the life of a license. The new bill will definitely fix the limit of time that a license will last and also will make certain that the Secretary of Commerce is authorized with complete powers of revocation of license. The revised rules will emphasize the fact that although a certain wave length may be assigned to such and such a licensee, this gives him no vested property right to any particular part of the ether. The bill will also contain certain carefully prepared provisions which will assure that licenses will be granted only to Americans and that their rights shall not be subsequently assignable except with the consent of the Secretary of Commerce.

The status of the amateur fixed very definitely by the radio act of 1912 will be respected religiously. His rights will be somewhat enlarged in the way of wave lengths to which he will be entitled. An assignment of wave lengths to amateurs up to 275 meters probably will be made. Under the present law, the amateur has wave lengths up to 200 meters. Under the revised rules, the amateurs, however, will not have exclusive use of the ether between 200 and 275 meters. A schedule of fees for licenses also probably will be included in the radio bill which is in the making. The service now costs the Government in the neighborhood of $250,000 a year and there is no reason why those for whom the regulations are made and the service maintained should not contribute in a small way to the support of the service. The fees will range from a nominal charge of 50 cents per annum to a maximum of $50. The larger tax will be assessed against the large trans-oceanic stations. The amateurs, for the most part, will have to pay only the minimum fee.

WHAT has happened to the new and revised radio laws that were to follow the Radio Conference and the numerous discussions in and out of radio regarding the present and future regulation of the broadcasting art? Has the matter been dropped? Or has the revision taken place under a mass of legal verbiage, and been overlooked by radio and other periodicals? Typical questions, these, at a time when everyone is interested in knowing what is to become of radio-phone broadcasting in the first place, and radio communication in general. Rest assured, however, that we have not lost sight of radio legislative measures. We have commissioned Mr. George H. Dacy of Washington, D. C., to follow the developments most carefully, and this he has done and continues to do. His present report is the third of a series that will be continued until the final regulations become law and they have been satisfactorily interpreted for our full understanding.—THE EDITOR.

Report of the Fourteenth Annual Conference on Weights and Measures

THERE was held last May at the National Bureau of Standards the Fourteenth Annual Conference on Weights and Measures, attended by officials from all sections of the country. These conferences have become one of the most important of the numerous meetings that take place each year at the bureau, and as a result of the papers presented and the discussions which take place, greater uniformity is being secured in the important matter of the weights and measures now in use in our various states and cities, and the regulations in force governing these.

It should be remembered that the National Government does not regulate these matters in this country. The enforcement of proper laws governing the use of weighing and measuring appliances is left entirely to the states and cities, a procedure which undoubtedly has some advantages and also some disadvantages, among which is the lack of uniformity in regulations in different parts of the United States. The weights and measures conferences, however, have done a great deal toward unifying and simplifying the various laws. At the last conference important work was done in framing a model law for the sale of bread by weight and in further improving the specifications for liquid measuring appliances.

A circular describing fully the results of the conference has recently been issued, known as Miscellaneous Publication No. 48 of the Bureau of Standards. It may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 20c per copy. The circular should prove of greatest interest to all those engaged in the construction, use or inspection of weighing and measuring appliances.

The Statistics of Climate

A Vast but Strikingly Inadequate Body of Scientific Data

THE making and recording of meteorological observations, day in and day out, is a process that goes on at some 35,000 places scattered over the globe. The total number of such observations taken every year amounts to at least fifteen million. Making due allowance for the fact that a majority of weather stations are of comparatively recent origin, while a few are from one to two centuries old, it appears that the existing data of climate are the final product of *several hundred million* observations of the weather.

Such being the case, it will perhaps be difficult to believe that practical questions which cannot be answered arise every day concerning the climatic conditions prevailing in various parts of the world. This statement does not apply merely to uncivilized or sparsely settled regions. There are obvious reasons why the climatic statistics for such regions should be scarce or non-existent; but it will doubtless surprise the average reader to learn that even for those parts of the globe where elaborate meteorological organizations have long flourished, including western Europe and the eastern United States, the climatic data hitherto assembled are still very far from sufficient to meet the demands constantly made for statistical information of this character. Not only are they insufficient in quantity, but they are, too often, inferior in quality, hard to interpret, strikingly heterogeneous, and extremely difficult of access.

In order to explain this curious situation, it is necessary, first of all, to consider what sort of data are included under the head of climatic statistics and why they are so included. The kinds of data comprised in a register of meteorological observations are not very numerous, even at fully equipped observatories, while at more modest stations they may be reduced to the readings of thermometers and rain-gages, and records of the wind and the state of the sky. Nevertheless, a little reflection will show that it is possible to deduce from a series of such figures an endless variety of sums, averages, groups, combinations, and what-not.

Supposing, for example, we have only the daily records of maximum and minimum temperature for a number of years at a particular place. From these we can obtain "normals" of the daily, monthly and yearly temperature (to say nothing of similar values for five-day and ten-day periods, weeks, seasons, and other intervals of time); mean daily, monthly and yearly "departures" from the normal; mean values of the interdiurnal variability of temperature; mean number of days having mean temperatures above or below certain limits; mean maximum, minimum and range for each day, each month and the year; averages of the absolute extremes and ranges for each month and the year, and absolute values for the entire period of observation. Such are only a part of the climatic data yielded by a simple pair of maximum and minimum thermometers. Side by side with average values the climatologist occasionally works up "frequency" values, and these are more useful for certain purposes than means. A mean is not, as a rule, the value that most frequently occurs. The fact that the mean temperature on January 1 at Blankville during the past 50 years has been 25 degrees is not inconsistent with the fact that the *most frequent* daily temperature for that date and place has been 29 degrees. If we add to the various data just mentioned the equally elaborate statistics obtainable from records of humidity, rainfall, snowfall, evaporation, barometric pressure, direction and force of the wind, kinds and amounts of clouds, duration of sunshine, etc., we shall eventually have enough statistical material concerning the climate of *a single place* to fill a ponderous volume, while the climatic statistics of a country would fill a big library.

As a matter of fact there exist monographs on the climates of individual places that comprise hundreds of pages. The criterion in the selection of the data to be included in such an array of climatic statistics is utility. It is because of the extremely varied applications of these statistics that there is need for such elaborate monographs. But this need has hitherto been met in only the most sporadic way, and it offers unbounded opportunities for fruitful labor on the part of climatologists.

What are climatic statistics good for? To this query one is tempted to retort: What are they *not* good for? Let us set down a few typical cases in which such data are desired.

A merchant plans to undertake the sale of rubber coats in foreign markets. Hence he wishes to know all about the distribution of rainfall, both geographically and as to season. Which are the rainy regions of the globe? When do the heaviest rains occur in each of these regions? Where do the prevailing temperatures indicate the need of heavy coats, and where light?

An invalid contemplates visiting a certain health resort. What mean temperatures occur there at the season of the proposed visit? What ranges of temperature between day and night? How much does the temperature vary from day to day? How much sunshine may be expected? Is the atmosphere moist or dry? What of the winds? Such are some of the questions he is likely to ask.

A horticulturist proposes to introduce a foreign plant in this country. Where will he find the most favorable climate for it? In order to settle this question he first tries to secure certain information about the climate of the plant's original habitat—the march of temperature through the season of growth, average dates of first and last frost, normal fluctuations of rainfall, humidity, sunshine, etc. In many cases such an inquiry would be fruitless. Perhaps the alien plant hails from a region that is climatically unexplored, or the available climatic data may not be of the right sort to fit this particular problem, or, finally, such data as there are may be impossible to locate in the enormous ill-digested literature of climatography. If the desired information is obtained, the next step is to ascertain where (if anywhere) similar climatic conditions prevail in the United States, and this is generally an easy task.

An engineer is planning a sewer system. He needs data of excessive rainfall for the locality under consideration, so that he may estimate the maximum amount of storm-water the sewers will ever need to

(Continued on page 70)

An Antediluvian Monster

Is the Argentine Plesiosaurus a Fake or a Scientific Marvel?

By Leonard Matters

WHATEVER may be the opinion in scientific circles—and it is one of scornful skepticism—the fact remains that the report of the existence in Argentina of a living specimen of a race of mammoth reptiles, supposed to have been extinct for millions of years, has excited intense interest. Every scientist of note has scoffed at the idea, but, headed by Dr. Clement Onelli, Director of the Zoological Gardens at Buenos Aires, there is a large body of Argentine public opinion strongly of opinion that a member of the plesiosaurus family will be discovered, alive or dead.

Dr. Onelli has disclosed to the press in Buenos Aires the fact that some time ago he received a letter from an American mining man down in Patagonia, reporting the existence of some monster, of a type well known to palentologists through fossil remains, but unknown to modern zoology. The American, a Mr. Sheffield, has been prospecting for gold along the Andes in the Territory of Chubut for many years, and Dr. Onelli says he knows him to be perfectly reliable. Mr. Sheffield wrote to the doctor stating that he had come across some enormous tracks near a lake. Bushes and undergrowth were trodden into the ground, and so deep were the tracks that they could only have been made by some living thing of ponderous weight. Continuing his account, Mr. Sheffield said: "I saw in the middle of the lake an animal with a huge neck like that of a swan, and the movement in the water made me suppose the beast to have a body like that of a crocodile."

Dr. Onelli has pointed out that Mr. Sheffield has given, for a layman, a remarkably accurate outline of the plesiosaurus, one of the mammoth reptiles that lived countless years before the ice-age, and became extinct during that geological epoch in the world's history. Moreover, the report recalls more than one similar story of the existence in Patagonia of some strange creature, never yet clearly identified. Patagonia was undoubtedly at some time the habitat of mammoth beasts, and prehistoric man. Extensive fossil beds have been located, and scientific knowledge has been widely enriched by the discovery of many kinds of extinct mammals and reptiles. Professor Frederic B. Loomis conducted an expedition through the Territory of Chubut in 1911, on behalf of Amherst College, and was successful in unearthing a petrified forest and, among other interesting fossils, the skull of a pyrotherium, an extinct elephantine creature.

There has long existed a romantic sort of idea that in the comparatively uninhabited parts of Patagonia, where certain forms of vertebrates are believed to have originated, a discovery would yet be made, of a nature that would stagger science—the finding of the "missing link," for instance, or more probably the capture of an actual living specimen of some supposedly extinct creature of antediluvian antiquity. Palentologists and scientists in general have never been associated with such a belief, but nevertheless it has been a popular fancy, and has not lacked some degree of support among men whose opinion carries weight. In announcing the latest report to the public Dr. Onelli has recalled this interesting speculation. He was personally first attracted by the idea 25 years ago when he was down in Patagonia. On the shores of White Lake there then lived a Chilean farmer who declared that often at night a strange noise could be heard, as though a cart were being dragged over the pebbly shore. It was asserted that on moonlight nights a huge beast could be seen in the lake. It had a long reptilian neck which rose high above the water, but when disturbed it would at once dive and disappear in the depths.

Ten years after hearing of the apparition in White Lake, Dr. Onelli heard of the discovery made by a Norwegian engineer named Vaag, who was a member of the commission of demarcation of the boundary between Argentina and Chile. Mr. Vaag gave the name of River Tamango to a waterway flowing from the Andes, on whose banks he found the remains of some great beast, and the tracks of a creature that probably resembled the plesiosaurus. Later on, in a cavern, further south at Ultima Esperanza (Last Hope) there were found the remains of a hide and many bones of a great quadruped. The condition of the hide and the fact that the bones were conserved in a gelatinous condition, gave rise to the belief that it might be possible to find a similar beast alive. These interesting discoveries led to a number of expeditions, to which popular imagination at least attracted the objective of looking for a surviving specimen of the mammoth age, even if the scientists themselves had no such belief in the idea. These expeditions worked in different parts of Patagonia, and made interesting discoveries, though they found nothing to warrant any credence in the popular theory supposing the existence of zoological phenomena.

This, in brief, is the history behind the most recent report made on the authority of Dr. Onelli. Science in general utterly discredits the suggestion that a plesiosaurus, or anything like the extinct reptile, is still alive, and the many scornful comments on Dr. Onelli's report leaves it doubtful whether scientists admit even the possibility of there being in Patagonia some unknown animal of large proportions. It has been hinted that the creature with the long swan-like neck is in the same class as the sea-serpent, and is really born in a bottle. However, the refusal of scientists to take Mr. Sheffield's story and Dr. Onelli's theory as credible, has not prevented the doctor and the Argentine people getting deeply interested in a proposal to fit out an expedition for the capture of the creature, alive or dead.

So seriously has the idea been taken up that a rather amusing development has followed. Dr. Albarrín, President of the Society for the Protection of Animals, has demanded that the Minister for the Interior shall stop the expedition, under Law No. 2,786, which prohibits the hunting and destruction of rare animals. Dr. Albarrín urges that if there should still exist a plesiosaurus, then Argentina possesses a scientific marvel of immense value, and it should neither be killed nor captured, but should be allowed to enjoy to the full the liberty it has had over millions of years. The worthy doctor claims that it would be more humane and creditable to Argentine culture to leave the creature where it is and let it reproduce its species.

When the Hand on the Throttle Fails

The Construction and Operation of the Webb Automatic Train-Stop System

By Robert G. Skerrett

THE greatest development in the art of automatic train stopping has been in connection with intermittent electrical contact apparatus. All of these depend upon a road-side auxiliary, called a ramp, to operate or to bring into an operative state the mechanism, carried by the locomotive, which actually applies the brakes or reduces the speed of the train.

The purpose of these equipments is primarily to halt or to slow up a train which is being run in violation of the warning of a signal immediately ahead; and this end is realized by a partial or a full application of the brakes. To those who may not be familiar with the working of railway air brakes, let it be said that the brakes are held away from the wheels by the maintenance of a prescribed pressure in what is termed the train pipe system. When, for any reason, this pressure drops, air, stored in auxiliary tanks under every car, is automatically released and led into the cylinders which cause the brakes to engage the wheels.

Automatic train control, therefore, involves the use of some facilities which may, in effect, move the brake-control lever in the locomotive cab if the engineer be unmindful of the position of the cautioning semaphore, or of the color of the guiding lamp at the beginning of the next block interval. Because of its simplicity and its positive mechanical functioning, the Webb automatic train-stop device is chosen for treatment in the present article to illustrate the basic principles employed in this class of railway safety appliances.

The Webb System performs a double service: it brings a train to a standstill when danger threatens, whether the train be going ahead or backing, and at the same time it sounds a warning which either the driver or the fireman should hear in time to put him on the alert. If, however, the object is to reduce the speed and not to halt the train, the engineman can check the exhaust of the air in the train-pipe so as to prevent a severe application of the brakes and to recover control over the movement of his train, provided he does not exceed the prescribed speed limit within the block he is entering. Should he be disposed to risk a prohibitive speed, a speed-checking governor intervenes.

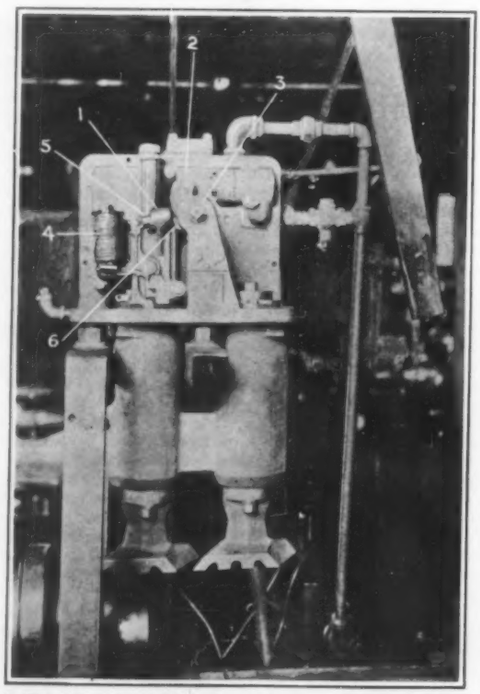
Broadly stated, the Webb apparatus is made up of two essential features—*i. e.*, a road element and a locomotive element—which are so brought together that they induce the regulation of a train's movement. The functioning of the locomotive element is effected through its contacts with the various ramps located along the roadway, and these contacts are made through the agency of a vertical plunger, which is a part of the locomotive equipment. The ramp feature of the system is a rail 34 feet long, which is set parallel with and fixed 17 inches outside the running rail at a distance of about 1600 feet before each block signal. To lessen the shock of impact and to graduate the up-and-down movement of the plunger, the ramp is sloped at both ends, and operative contact takes place throughout 22 feet of the face of the ramp. This rail is in the electric circuit of the block signal, and receives its energizing current from the same stationary source—*i. e.*, the local battery.

A strong spring holds the vertical plunger at its lower and normal position, and the same helix assures firm contact during travel upon the ramp. The nether end of the plunger carries a corrugated cast-iron shoe so designed that it will scrape away snow, ice, and frost, and thus insure intimate association between the ramp and the shoe in all sorts of weather. The plunger is supported by a sturdy cylinder, and when pushed upward half an inch, on meeting the ramp, the motion so imparted serves, through interposed elements, to rotate a cam sufficiently to open the air valve of the engineer's brake control. At the same time, the air, which is thus allowed to escape from the train-pipe, reaches the atmosphere through a whistle in the cab, and the driver or his assistant is warned. Depending upon the nature of the control exercised by the ramp, the whistle blast is a long or a short one.

If the semaphore signals "proceed," current is fed to the ramp, and as the shoe meets the ramp the air valve on the locomotive is opened, only to be closed again as soon as the ramp is passed. This takes place so quickly that the brakes are not brought into play. The reason for this is that the current from the ramp passes upward through the shoe and the plunger to a magnet; and the magnet, so energized, is instrumental in causing the projection of a bolt which, when the plunger descends on leaving the ramp, engages a lug or shoulder on the cam and closes the air valve. During this interval the cab whistle sounds a short blast.

Erie locomotive equipped with the Webb automatic stop, which appears at the extreme left, as indicated by the arrow

Should the block signal be at the "stop" position, at which time the ramp is not energized, then the magnet of the train-control mechanism remains inert; the bolt referred to will not be projected; and the plunger will not reverse the cam shaft and shut off the brake-control air valve. As a result, the pressure in the train-pipe will fall so that the air system under the several cars will react and produce an emergency application of the brakes. When operating in this manner, the apparatus will give a long blast on the cab whistle. Similarly, should the current fail to reach the ramp, owing to an electrical breakdown, the train will be halted.



1. The plunger head which rises and engages lug 2 on the air-valve cam 3. The magnet 4, when energized, projects bolt 5 to engage lug 6 on the air-valve cam when the plunger descends. This action closes the air-valve, which has been opened by lug 2. If the magnet is not energized, lug 6 does not act, and the brakes are automatically applied in an emergency stop

How the Webb control apparatus works

This automatic train stop is the invention of Jean F. Webb, Jr., and was given its first service tests during 1915. Since then, the device has been improved in some particulars while still retaining its basic simplicity. Today the shoe and some other elements of the equipment are hollowed out and connected with the brake air-line. Therefore, should the shoe or the associate features referred to be fractured by an unexpected blow, the air will escape from the train-pipe and the train will come to a halt. It takes only a few minutes to replace a broken shoe. In its present form, the locomotive element is provided with a pilot plunger whose sole purpose is to make more certain the removal of snow, ice, frost, or frozen mud so that the electrical contact of the following operating shoe will be a perfect one. It is said that the apparatus has never failed to function because of faulty electrical contact.

The system includes a governor which prevents the engine driver from releasing his brakes, should a stop be called for, except when the speed of his train is kept below 20 miles an hour. That is to say, should the brakes be automatically applied, and the engineer then decide to go on, the governor checks him and imposes a speed which will make it possible to halt the train quickly if need be. Full control of the train is restored to the man in the cab at the next ramp, if the way is clear. This governor, however, is not necessarily an integral part of the train-stop apparatus. From what has been described of the Webb system, it should be plain that it is designed to arrest a train whenever there is danger ahead or whenever the operating mechanisms are broken or disarranged in any essential respect; and if the engineer be unmindful of the signal he is approaching, then the cab whistle will invariably remind him of his neglect.

Last September, a demonstrating installation was made on the Erie Railroad at a point between Ridgefield and Morsemere, New Jersey. A single contact ramp was placed on the eastbound track 1606 feet west of one of the block signals on that division of the line. An engine was equipped for the trials, and this locomotive was coupled to a train made up of eight steel coaches. A program was carried out which covered practically all conditions that might be met with in regular service; and the apparatus performed successively in every case.

Probably one of the most interesting of the tests was that which called for the block signal at the "stop" position, and for the train to be run over the ramp at full speed. The engineer, as an "alive and alert driver" would do on seeing the semaphore set at "stop," was required to make an "emergency" application with his own brake valve when the audible cab signal should indicate the stopping action of the automatic device. This is what happened: As the train, at a velocity of 40 miles an hour, reached the "third rail," both contact shoes were broken off by the impact, evidently caused by imperfections in the castings, and while no audible signal was given in the cab the train was automatically brought to a standstill at a point 632 feet short of the signal tower.

Again, with the automatic signal at "clear," the battery was disconnected so that the ramp could not be energized—the object being to simulate an electrical breakdown, and the train was rushed at the ramp at a speed of 45 miles an hour. The apparatus worked perfectly, and the train was halted automatically within a distance of 1158 feet. All told, nine different tests were made; and the performances were entirely satisfactory to the railroad officials. The equipment, as tried out, was purely an automatic train-stop mechanism, and did not include the automatic speed-control feature. It is recognized that the addition of such a feature entails the employment of more or less delicate adjuncts, and, even if they worked as designed, would undoubtedly impose higher maintenance costs. A careful engineer would not resume high speed unless he ascertained the cause for the automatic application of the brakes and was assured that he could safely go on.

The concluding paragraph of the railroad's report upon the foregoing tests of the Webb system has this to say: "The device tested is built along the lines of simplicity, is very ruggedly constructed, and unquestionably possesses many features which the Interstate Commerce Commission specifications will insist upon."

Wireless from Trains in Germany

COMMUNICATION from moving trains is already a possibility, and already practiced, in emergency. But we are still a goodly distance from the epoch at which we shall look upon such communication as forming just as integral a part of the journey as the berth-light or the newspaper-and-magazine vendor. Germany, however, is moving in the right direction, as the accompanying photographs show. The installation pictured is on the Berlin-Hamburg line, and we are given to understand that it is intended as a permanent feature of all the high-class trains on this route, and in no sense as an ephemeral "stunt." Each car has its own antennae and, inside, its own telephone apparatus. Thus Herr Hans Geschäftsmann or the worthy Fritz Hohenflieger, on the way home to Berlin from a business trip or a sporting outing in Hamburg, can now phone his good Frau to put the dinner on and have the meal ready—or, in the event of a train delay, the reverse.

German train with radiophone equipment, and a close-up of the car top showing the six-wire antenna

Something New in Movie Scenery

A NEW invention, experiments with which have just been completed with complete success, bids fair to revolutionize the making of motion-picture scenery.

The discovery in question is a process by which it is possible to enlarge ordinary photographic plates to 15 x 20-foot reproductions. These huge enlargements, real photographs that they are, are designed to replace painted scenery in the movies.

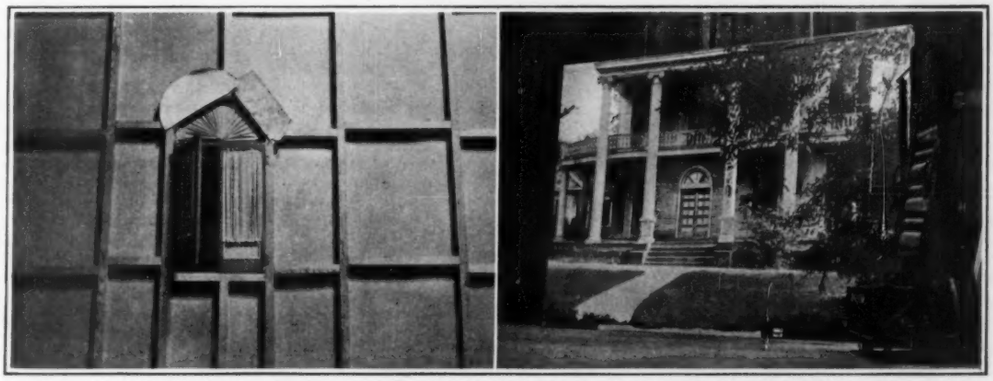
Heretofore, the size of enlargements has been limited, due to the fact that the picture became "fuzzy" and out of focus when enlarged very greatly. The present process enables the making of 15x20-foot reproductions that are sharp and clear in every respect.

As the first of the photographic scenery is being utilized, the mode of operation consists of going out and photographing a house, bit of scenery, or other desired location in the ordinary way. One of the big enlargements is then made and mounted on heavy framework. It is then ready for use. In case doors that open are desired, it is a simple matter to insert them in the big picture.

From this point on, the employment of the photographic scenery is exactly the same as that of the ordinary kind.

It can be readily understood that a process of this sort, which will enable a motion-picture company so easily to bring to the studio, with its perfect production facilities, the desired bits of exterior scenery in this way, has unending possibilities. The artistic opportunities thus created are a vast improvement over the ordinary ones, while the very real financial saving must also be figured into the balance.

A picture using several pieces of photographic scenery was recently completed at a studio in Los Angeles and was a success in every way. More elaborate scenes are now being constructed and it appears as though the possibilities of the radical departure in movie sets are unlimited.



Left: A real door in a wall that exists only as a photograph. *Right:* If the producer can use photographic backgrounds like this with success, there will be much less skirmishing about our big cities in search of suitable "locations," and less "shooting" in the public streets

Motion picture scenery that is itself merely photographic, seen from the rear and front

Airplane Service in Europe

THE airplane service in Europe is not yet on a remunerative basis, according to a recent report from Consul Frank W. Mahin, of Amsterdam. Government subsidies are needed to keep it alive.

The Netherlands Government estimates 370,000 florins ($148,740 at the normal exchange rate) as a subsidy, for the year 1922, for the service between Amsterdam and London, which is operated by a Dutch company. England plans to subsidize the English air service from London to Paris, Belgium and Amsterdam, which seems to mean that a British company will compete with the Dutch between Amsterdam and London. France and Belgium grant varying sums toward payment of pilots, cost of benzine, etc. Germany gives a premium on the number of kilometers flown.

In spite of subsidies, however, it was decided to discontinue the air service between Amsterdam and German cities from October 1 until next spring. The service between Amsterdam and London, and Amsterdam and Paris will, however, be continued without interruption during the winter.

The inventor of the duplex piano giving a recital to a London audience

Taking the Tricks Out of Piano-Playing

FROM Vevey, in Switzerland, comes the latest version of the simplified piano. And this invention of Emmanuel Moor is free from the objection which has damned most of its predecessors—one can play it just like a regular piano if he prefers, taking just as much and just as little advantage of the novel features as his pleasure dictates.

The new piano has two keyboards, of which the lower is the familiar one of all instruments. Each key on the upper board sounds the octave of the corresponding key below; and by an octave-coupler attachment octaves can be played, as on the organ, as single notes, while tenths are immediately reduced to thirds with an immense gain in facility. All the stunts requiring extreme manual dexterity, which make difficult pieces difficult, are simplified to the obvious extent of bringing eight keys nearer together the notes that have to be struck simultaneously or in succession. Big spreading chords lie right under the hand; big jumps are cut to short ones, or become no more jumps at all; and cross-hand passages cease to exist.

An interesting detail of the new construction is that the white keys of the lower board, for an inch or so at their extreme base, are elevated to the same level as the black notes. This level at the same time is that of the upper board. By making the stroke at the junction point of the two keyboards a great many double effects are reduced to single ones.

The octave-coupler, incidentally, is not reversible. One presses a pedal, and instantaneously the upper board is coupled to the lower, so that pressing any of the lower keys strikes the octave. But the upper board is still free to respond to the finger without involving the lower, for the coupling is strictly a one-way proposition; so one may play octaves with one hand on the lower board with the coupler depressed, and at the same time strike single notes, chords, etc., with the other hand on the upper board. Distinguished critics have pronounced the new device to be an epoch-making invention in music.

Aviation in the Far East

THE first Japanese overseas long-distance aerial flight was held between November 10 and 20 under the auspices of the Imperial Aeronautical Association, Tokio, according to the *Far Eastern Review*. The distance covered was 1300 kilometers (807 miles), for which the time required was set at eight hours. Twenty-five large army airplanes, capable of carrying 15 men and flying uninterruptedly for 16 hours, which were ordered from France, arrived. These airplanes are for the purpose of dropping bombs and carrying war supplies.

The Chinese air service, Peking-Kansu, began in November. The station at Lanchow and Ping-liang, Kansu Province, has a length of 300 feet and a width of 100 feet. Aviators in Szechuan have put up a capital of $600,000 for the establishment of an aerial transportation center. They plan to purchase four large seaplanes, each having a capacity of carrying 30 passengers, and several smaller ones and a number of motor boats. The company, under the name of the Chuan-Kiang Aerial Company, which name, however, has been ordered to be changed by the Government, has applied for registration. A French merchant preparing to start a commercial service between Szechuan and the Yangtze has been refused government permission.

Fulfilling the Treaty

Turning Battleships Into Merchantable Scrap at Philadelphia

By H. A. MacMullan

THE dismantling of the large tonnage of various units of the United States Navy, ranging from our first little submarine, "A-1 Plunger," and the monitor "Monterey," built in 1887, to the predreadnought type battleship "Maine," at Philadelphia, is not only the beginning of a new industry in this country, but it marks the destruction of a naval tonnage greater than that of Italy at the beginning of the World War.

Although they are engaged in destroying a large section of the world's second most powerful naval force, the powerful acetylene torches that cut through the 11-inch nickel-steel armor of the now obsolete battleships and through the extremely light shell of the old submarine, cannot efface from the record of the Navy the part which these condemned craft played in its upbuilding.

The after turret of the "Missouri." Note the two holes in the 12-inch guns, a few feet from the muzzle. They were burned through with the torch, to prevent subsequent use.

The monitor "Monterey," with her sister ships "Ozark" and "Tonopah," were, in the nineties, powerful craft for their day. Modernized editions of Ericsson's Civil War "Monitor," they represented the ideas of that school of design, which believed that the defense of the country could be assured by low-freeboard, non-seagoing vessels, armed with powerful rifled guns. They embodied the ultimate development of the Ericsson monitor.

The destroyer "Stewart," which is being converted into a coastwise banana boat for the Caribbean Sea, was commissioned 20 years ago; nevertheless, she sunk a German submarine which was attacking its convoy off Brest, April 23, 1918, and was awarded the metal star given vessels that had sunk an enemy undersea boat.

The little "A-1 Plunger," with its gasoline engine, single torpedo tube and crew of eight, was the grandfather of the modern submarine cruiser of today. Built by J. P. Holland, the early trials of the "A-1" met with almost as much ridicule as those of Fulton on the Hudson River. Yet the basic principles are the same as those developed into the "S-41" nearly 25 years later.

The Limitation of Armament Conference at Washington, by restricting the completed and under-construction naval program of the United States from approximately 1,370,000 tons to 525,000 tons is responsible for the creation of this new industry of ship scrapping, by throwing upon the market for sale 845,000 tons of ships that were built or under construction.

Among the units already taken over for dismantling and now lying at anchor along the 1000-foot river waterfront of the Hitner company's yard are the battleships "Wisconsin," "Missouri," and "Maine"; cruisers "Columbia," "Raleigh," and "Detroit"; and the destroyers "Stewart," "Perry," "Bainbridge," "Barry," "Dale," "Paul Jones," "Hull," "Lawrence," "Preble," "Smith," and "Decatur."

The monitors include the "Tonopah," "Monterey," "Ozark," "Canonicus," "Manhattan," "Mahopac," Catskill," "Jason," "Ajax," "Nahant," "Miantanomah" and "Puritan."

Then there are Eagle boats, submarine chasers, mine sweepers and submarines, as well as two old English troopships, H. M. S. "Malabar" and "Hotspur," which now lie in the berths where the international cup defender "Columbia" and Admiral Franklin's old flagship the "Franklin" were previously wrecked by the Hitners.

Special equipment and the most powerful oxy-acetylene and electric torches have been developed for the scrapping of these ships. Take the 13,500-ton "Maine" as an example of the method followed in breaking up these once powerful units of the Atlantic Fleet.

The first step in dismantlement is to remove the armor plate in sections weighing from 25 to 40 tons. These are swung to a horizontal position in the yard, where oxy-acetylene torches cut through the 11-inch armor into pieces measuring 2' x 5', a size which may be readily fed into the charging boxes of open-hearth furnaces. The valuable alloy content of nickel-steel in this "scrap" makes it one of the most desirable by-products which finds its principal market in the automobile industry.

The nerve centers of the ship are then attacked—the machinery which operated gun turrets, ammunition hoists, refrigerating systems and all other intricate mechanism are broken into small pieces readily handled by a single workman. This small scrap is for the most part turned over to gray iron foundries and, after treatment in combination with low-grade iron ore, reappears in the frames of harvesting and other agricultural machinery, engine bases and low tensile strength iron products.

One of the most valuable by-products is the composition navy metal, which is made up of 88 per cent copper, 10 per cent tin and 2 per cent zinc and has a tensile strength of 40,000 pounds to the square inch. Other precious "junk" is the copper, gun metal, manganese-bronze, lead, zinc and navy brass, all of which are sorted into their different grades, melted up in smelters into ingot form and sold to manufacturers in practically every branch of the metal trade.

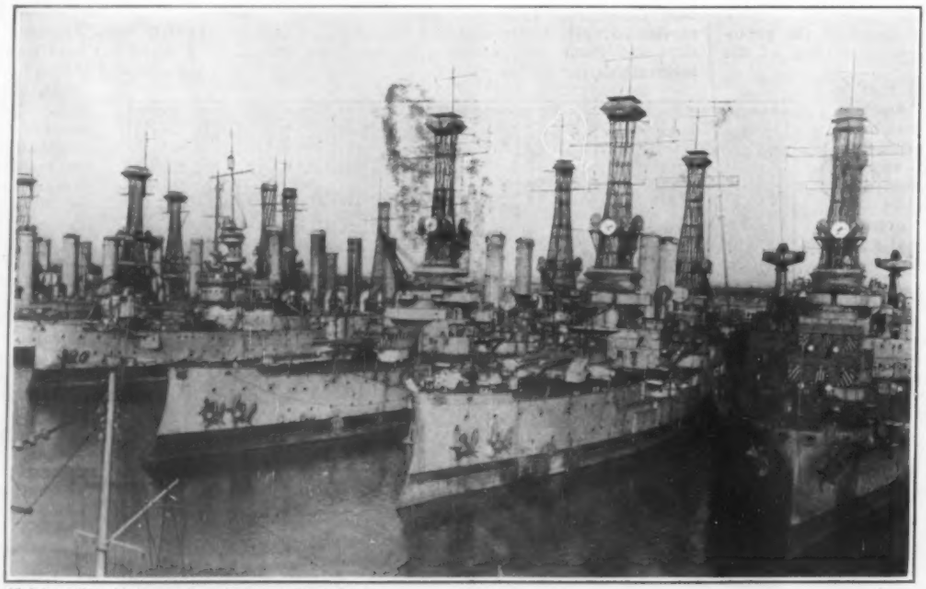
Total annihilation is not to be the fate of all the former fighting craft. The hulls of some, as in the case of the "Truxton," "Worden" and "Whipple," will be converted into fruit boats. Re-engined with kerosene oil burners, the clean lines of these former destroyers are favorable to speed with comparatively low-powered equipment. This makes the expensive refrigerating machinery, essential to slow boats, unnecessary in their case. They are also money-savers in lighterage costs, as their draft is so small they are able to go up shallow rivers on high tide and lay off plantations for loading.

When not so converted, the 50-odd destroyers purchased by the Hitner firm are being ripped apart by powerful chisels operated with compressed air devices. Ten-ton crocodile shears bite through the destroyer plating as though it were cheese, and these pieces are re-melted into ingots and rolled into various shapes for structural steel, rails, sheet plate and other industrial uses.

The old English troop ships are particularly valuable from the standpoint of "junk." They are constructed of purest wrought iron, almost equal in strength to the composition navy metal; and after being treated through several processes, this iron finds its way to stay-bolts and other forms requiring a rust-resisting metal.

What The Treaty Left Us

THE foregoing article has given a rather dramatic evidence of the inroads which the Limitation of Armaments Treaty made on our fleet; but we must remember that the knife cut just as deeply into the fleets of Great Britain and Japan, the two countries which met us in amicable discussion of this great problem. Assistant Secretary of the Navy Roosevelt recently told us that the United States moves up to the position of equality with Great Britain, and superiority to the navies of the other powers, at a greatly decreased cost compared to what it would cost us to reach this position had naval competition proceeded. He tells us that if the building programs had been carried out, the heavy fighting strength of our navy, compared with that of the others, would have stood: United States 100, Great Britain 106, and Japan 87; whereas, by the Treaty the ratio has been fixed at United States 100, Great Britain 100, and Japan 60. Furthermore, we have attained this position with an enormous decrease in both the cost and maintenance of our navy. Mr. Roosevelt tells us that to have completed the 1916 building program would have cost approximately $200,000,000 a year, and the cost of supporting our navy



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Group of old battleships, lying at the Philadelphia Navy Yard, which are now being scrapped in accordance with the recent Treaty

would also have been increased by a like amount.

The people of the United States are well aware that an active propaganda, largely religio-political in its origin, has been carried on to disparage the Treaty, and keep alive a spirit of distrust and hostility against the two other naval powers who were principally affected by the Treaty. If the agitation were prompted by patriotic consideration of the interest of the United States, it would be understandable, even though it is mistaken as to the actual facts, as Mr. Roosevelt has shown. As it is, such criticism is unpatriotic, destructive, and highly reprehensible.

Not only has our position in the front rank been made secure by a solemn Treaty, but an analysis of the battleship strength of the two leading navies—our own and that of Great Britain—shows that so far as material is concerned our first fighting line is fully equal to that of Great Britain's, and would seem to the naval expert to be essentially stronger. Against our three 32,600-ton ships of the "Maryland" class, each armed with eight 16-inch guns, Great Britain has nothing to show except two 16-inch gun, 35,000 ton ships, whose designs are not even yet completed, and whose commissioning is not likely before three years from the present date. Against these three ships and our seven ships of the "California" and "Pennsylvania" classes, of from 31,400 to 32,300 tons, all armed with twelve 14-inch guns, and our four ships of the "Oklahoma" and "Texas" classes, of 27,500 and 27,600 tons, each armed with ten 14-inch guns she can show ten ships of from 28,925 and 26,600 tons, each carrying eight 15-inch guns, and four ships of the "Benbow" class, of 25,850 tons, armed with ten 13.5-inch guns. The leading British battleships can deliver a broadside of 658,400 foot-tons energy, whereas our "California" and "Pennsylvania" vessels have, respectively, a broadside energy of 914,160 foot-tons, and 787,272 foot-tons.

It is the "shots that hit which count," and twelve 14-inch guns of the "California" class, delivering 50 per cent more projectiles in a given time than the eight 15-inch guns of the "Royal Sovereign" class, would, with equal gunnery, secure 50 per cent more hits.

Whittling Iron and What It Is

VERY few have ever heard of "whittling iron," or iron that could actually be whittled or cut with a knife. But it seems that there have been cases of such a nature which have puzzled scientists and others. The most interesting account of this is the following:

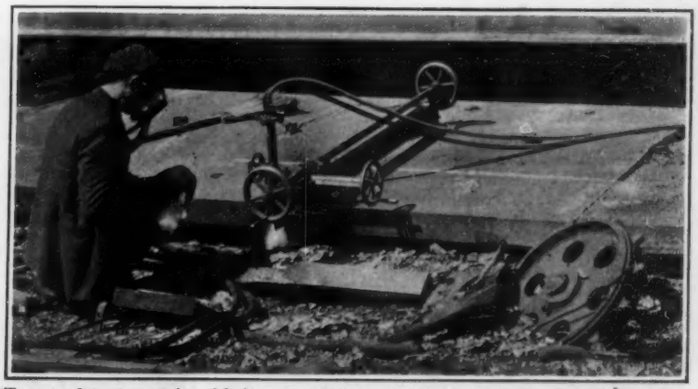
In 1545 the "Mary Rose" capsized off Spithead, England. She carried some wrought-iron guns and cast-iron shot. After 292 years in the sea, on being brought into the air the shot gradually became red hot, then fell to pieces. A similar fate overtook the "Royal George" in 1872 in the same locality, and 62 years later some iron guns were rescued from the wreck. After 133 years' submergence, some cannon and shot were brought up from the "Edgar" also.

It is recorded that the cast iron from the latter two vessels was generally soft, so that it could be cut with a knife, resembling plumbago. Wrought iron on these ships was not so seriously injured. While in this soft state some of the old cannon were taken carefully to the Tower of London. In the minutes of the Proceedings of the (British) Institution of Civil Engineers, about eight years ago, Major General Palsey records that after a time these cannon resumed their original hardness. The same authority declares that iron parts of pumps immersed in mineralized waters were similarly affected. Another authority states that the old guns mentioned were again fired. Cast-iron piles along the English coast likewise deteriorated.

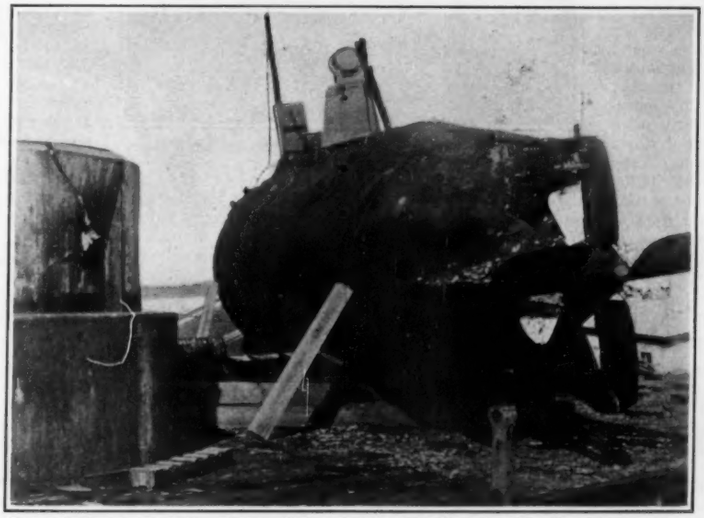
In the Transactions of the American Society of Civil Engineers for 1915 Marshall R. Pugh narrates that "the cast-iron guns from some ancient pirate ship were brought up from the ocean depths off Holyhead in 1882, after the lapse of a century. They were quite soft, but hardened so much on exposure to the air that they were used to fire salutes to King George IV when he passed through Holyhead on his way to Dublin. These old guns were said to have given louder reports than any others."

Old sea tales might be multiplied. Modern shipbuilders, too, state that in repair work cast-iron parts exposed to sea water are frequently found in the condition described, at least in spots.

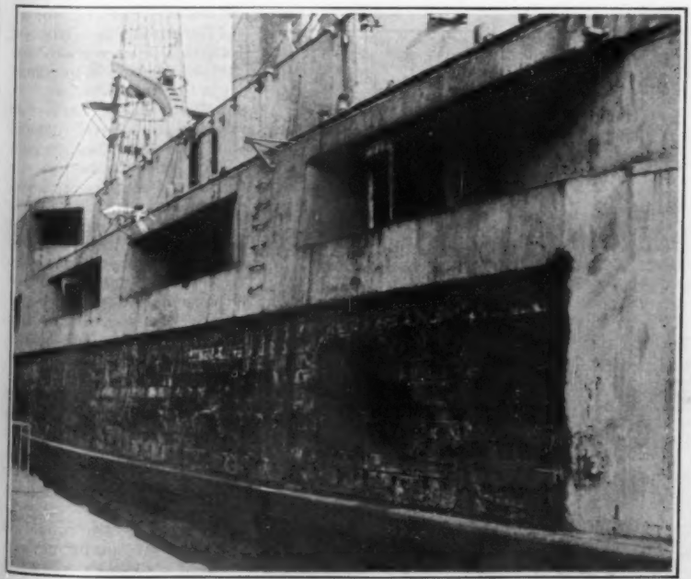
Iron pipes along the seaboard are so deteriorated by salt water as to need replacement, in some places, within a few years, while in other places a generation, or even two, may pass. This deterioration appears to be more rapid in tidal marsh land than in seaways. It has been learned also that coal ashes and certain industrial wastes deposited on the land, through leaching, cause the same unfortunate results. Likewise pipes and other iron objects in alkaline, acid or saline soils in many localities suffer deterioration. All kinds of iron are not affected, nor is the action uniform. A more thorough investigation than has ever been undertaken is demanded. Engineering Foundation is endeavoring to organize a research that will get valuable results. Information concerning the trouble must be countered by scientific knowledge of causes and means for avoidance or resistance. Manifestly, it is undesirable to have iron in pipes or structures become soft enough to be whittled with a jackknife, and in extreme cases as soft as putty.



Twenty-four-ton strip of belt armor being cut into 5-foot, open-hearth furnace billets with the oxy-aceteline torch



Fore deck of partially dismantled monitor "Puritan," with the Navy's first submarine "A-1 Plunger," being scrapped upon her deck



Close-up view of battleship "Maine," showing the gap left by the removal of her 11-inch belt armor

Drouth Periods and Sun Spots

A CRITICAL examination of the records for six important periods show three consecutive years of drouth in the period of 1915-1919, three in 1892-1896, four in 1869-1873 and three in 1858-1862. Of the others, 1881-1885 contained three years of moderate drouth intensity and 1905-1909 a single year. In seeking a possible relation between this and the sun-spot numbers, it was found that the four periods of critical drouth entered on maxima of 85 or more spots, while the maxima of the other two periods were 64 and 62, respectively. The greatest number of spots recorded for any maximum is 154 for the maximum of 1778. Hence the maxima which correspond to periods of intense drouth are characterized by spot numbers in excess of half of the greatest number known for any year's sun-spot maximum, while those of the periods of 1905-1909 and 1881-1885 are below the half of this number. The crest of the curve for these two periods is also very flat. In consequence, it may be said that a critical drouth period has occurred in the West since 1858, and perhaps since 1835, at each sun-spot maximum for which the spot number was greater than half the number known for the year maximum. This does not mean that drouth years have not occurred at other times, but a preliminary examination of the records for the years centering about the sun-spot minima shows no general and critical drouth throughout the West at such times. The periods of the minimum are now being analyzed with reference to this point, as also to the relation of the sun-spot minimum to increased or excessive rainfall. In addition, all station records of 20 years or longer are being charted as columnar graphs for the purpose of throwing light on the 2-3-year cycle and on the question of its relationship to the sun-spot cycle. In both cases it is hoped that a clew may be found to the operation of the excess-deficit balance, and its effect in modifying conditions at the sun-spot maximum or minimum. This relation is suggested by the fact that each drouth period in the table is either ushered in or closed by a year of excessive rainfall.

The importance to agriculture, grazing and forestry of being able to anticipate periods of serious drouth is evident. The periods of critical drouth have had disastrous effects upon the settlement and development of the West, and similar consequences must be expected until the recurrence of drouth is accepted as inevitable, and proper precautions taken against it. The extent to which the sun-spot cycle can be utilized in predicting periods of drouth or wetness can be determined only by actual trial. The success attending the first attempt to do this may have been purely accidental. However, the present study seems to indicate clearly the basic importance of the sun-spot cycle for long-range forecasting.—*F. E. Clements, Carnegie Institution, in Ecology for July, 1921.*

Tamed Lightning

Dr. Steinmetz' Small-Scale Duplication of Nature's Discharge

BY means of a special apparatus which reproduces actual lightning and is known as a "lightning generator," the laboratory of Dr. Charles P. Steinmetz, chief consulting engineer of the General Electric Company, is making the most successful tests of lightning arresters that have ever been conducted.

The artificial lightning which Dr. Steinmetz and his laboratory coworkers, J. L. R. Hayden and N. A. Lougee, have succeeded in producing for these purposes, has about one five-hundredth of the horsepower possessed by the lightning flash of nature. It has only one five-hundredth as much voltage. But except in the matter of magnitude it is exactly the same sort of energy, stored up and discharged in the same way, as is the gigantic lightning bolt of an electrical storm in the heavens.

Any object that is placed in the path of the artificial lightning stroke is torn to pieces just as truly as it would be if it were in the path of natural lightning. The laboratory bolt has shattered blocks of wood and small tree branches, scattering them in all directions.

The object is exposed to the lightning by being physically connected to the wiring which is used as the directive path of the man-made lightning. A nail is driven into each end of the wood, and the wires are wound around the nails, so that the block hangs suspended in the circuit through which the lightning will travel.

When lightning arresters are tested by this imitation thunder-storm machine, they are connected up in the same manner, so that the lightning will affect them in the same way that natural lightning would. They are also connected to the lighting circuit of the building, so that they are in effect protecting the lighting circuit against a bolt of laboratory lightning, just as in actual service they would be called upon to guard a transmission line against natural lightning.

Valuable discoveries have been made by this means in the behavior of lightning arresters in service, because by means of the lightning generator, lightning can be duplicated on a small scale at will, and also can be controlled and experimented with. Unusually severe service conditions can be produced, and the action of the lightning arresters can be observed with accuracy. It has been found that the causes for the occasional failure of lightning arresters to function in actual use are far different from what has heretofore been imagined.

Dr. Steinmetz has always been a student of lightning. But the possibilities of actually reproducing lightning in his laboratory were first suggested to him about two years ago when his summer camp on the Mohawk River, near Schenectady, N. Y., was struck by lightning.

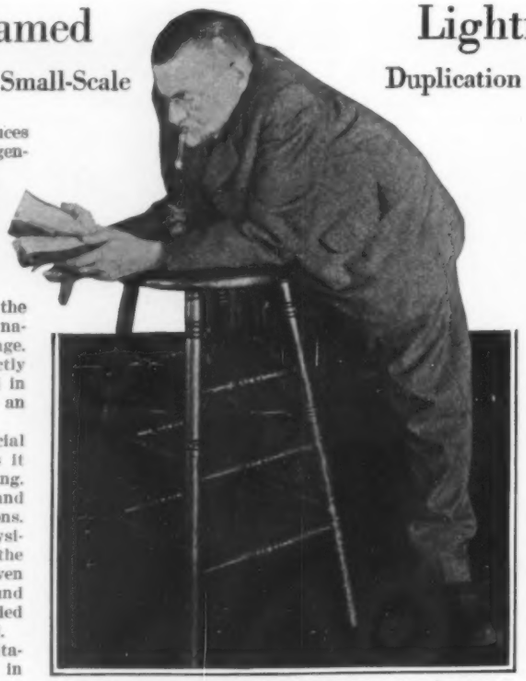
This was an isolated case, which gave him exactly the opportunity he needed to study the phenomenon. He reached the camp within 24 hours, took photographs of the damage and gathered useful data.

He found the lightning had struck a tree, jumped to the camp and divided, one fork passing to the ground through a post and the other shattering a window, setting up an oscillation in the camp's local lighting circuit and then following several paths. It shattered or splintered several supporting posts in various locations, a screen door, a bed and a looking-glass. The glass was shattered into many pieces, and the fragments were thrown across the room.

A careful study of what this bolt of lightning had done was in itself illuminating to the men of science. Now, however, Dr. Steinmetz and his assistants, Mr. Hayden and Mr. Lougee, have duplicated in miniature the energy and behavior of lightning.

Differing only in magnitude, their lightning is just like nature's article. Like nature's, it can also splinter objects and throw the fragments across a room.

Their lightning generator does ingeniously just what the thunder-cloud in the sky does during an electrical storm. It slowly generates electrical energy, storing it up gradually, until an overcharged condition is reached. Then, in a flash, the stored energy is discharged, and anything that is in its path is "struck by lightning."



Dr. Steinmetz examining the fragments of a tree struck by lightning

In the artificial lightning stroke, a voltage of 120,000 volts was chosen as most convenient. The voltage of the lightning flash of a thunder-storm has been estimated by Dr. Steinmetz at fifty million volts.

The artificial lightning represents, while it lasts, more than a million horsepower. The estimated horsepower of a natural lightning flash is given as 500 million horsepower. The million horsepower of the man-made lightning, like the 500 million horsepower in nature's lightning, would not be very useful for practical purposes, because it lasts such a brief instant. It lasts about a hundred thousandth of a second.

It is true, the natural lightning flash has about 500 times as much horsepower. The difference in energy therefore appears colossal. But the difference in the nature of its action and effects is practically zero. Only, while Nature's lightning shatters and tears a whole tree, the man-made lightning does the same with a piece of a smaller tree.

And yet, according to the laboratory specialists, it is theoretically possible to construct an apparatus which would reproduce Nature's lightning in all its magnitude. It would not be practical to do this, for it would mean apparatus of stupendous size and complexity; and it would not be desirable, as it would not be safe to approach near enough to watch it. But the same applied principle would operate as in the case of the lightning generator now in successful use.

This generator consists essentially of a high voltage condenser of large capacity in the form of 200 large glass plates. These are arranged in groups of fifty and in two banks, or rows. The rectified direct current is stored up in these condensers, which are connected up so as to be capable of holding 120,000 volts.

One end of the double row of condensers corresponds to the thunder-cloud in the sky, in which an electric charge is gradually stored up and increased by the conglomeration of the rain drops, as Dr. Steinmetz has shown. The other end of the condenser plates corresponds to the earth.

When the tension of the stored-up electric energy becomes greater than the lightning generator will hold—and the tension which it will hold is 120,000 volts—or, in the case of natural lightning, becomes greater than the thunder-cloud will hold, whatever the amount of tension may be, the discharge takes place. The lightning flash is seen, the thunder rolls—represented, in the case of the lightning generator, by a loud snapping sound—and the bolt strikes.

"Higher voltages than we use in this generator have been produced," said Dr. Steinmetz, "and have been talked about as 'lightning.' But mere high voltage is not lightning and has no similarity to lightning in its action and effects. The characteristic of lightning is high voltage backed by large power, lasting for a very short time and so giving explosive effects.

"In the high frequency experiments of Prof. Thomson, Telsa and others, the voltage was very high, but with little power back of it; and even with a million volts, at Pittsfield, the current was a fraction of an ampere. Thus the explosive effects characteristic of lightning was entirely absent.

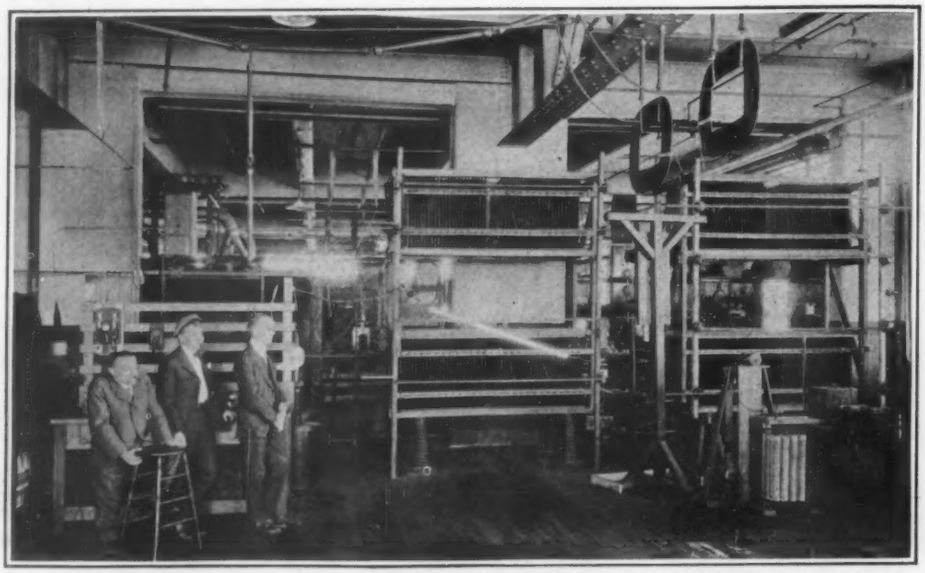
"In our lightning generator, we get a discharge of ten thousand amperes, at over a hundred thousand volts, that is, a power of over a million horsepower lasting for a hundred thousandth of a second. This gives us the explosive, tearing and shattering effects of real lightning, so that, for instance, a piece of a small tree, exposed to the discharge, is torn to pieces. A piece of wire struck by it vanishes in dust.

"The difference is similar to that between a pound of dynamite and a pint of gasoline; the pint of gasoline contains more energy and can do more work; but the pint of gasoline gives off its energy only slowly, at a moderate rate of power, while the pound of dynamite gives off its energy explosively, all at once, at an enormous rate of power."

The surprising advance of electrical science which these things indicate was pointed out by Dr. Steinmetz.

"When Edison ran his first circuits for electric lighting in New York City, he used 220 volts. Today we are sending electric power across the country at 220,000 volts. Thus, in 40 years since Edison's first installation, we have increased the voltage in our electric circuits a thousand-fold; we have produced and played with over a million volts, and the voltage of the thunder-cloud is only 50 times higher than what man has produced. So you see, the step from the highest voltage now used to that of lightning is less than was the step which the electrical industry has taken in 40 years."

All of which would be rather fascinating news to sagacious Ben Franklin, first man to seek a speaking acquaintance with a flash of lightning.



The lightning generator, showing the vivid white flash of the artificial lightning at the moment of the discharge

Belgium's Giant Radio Station

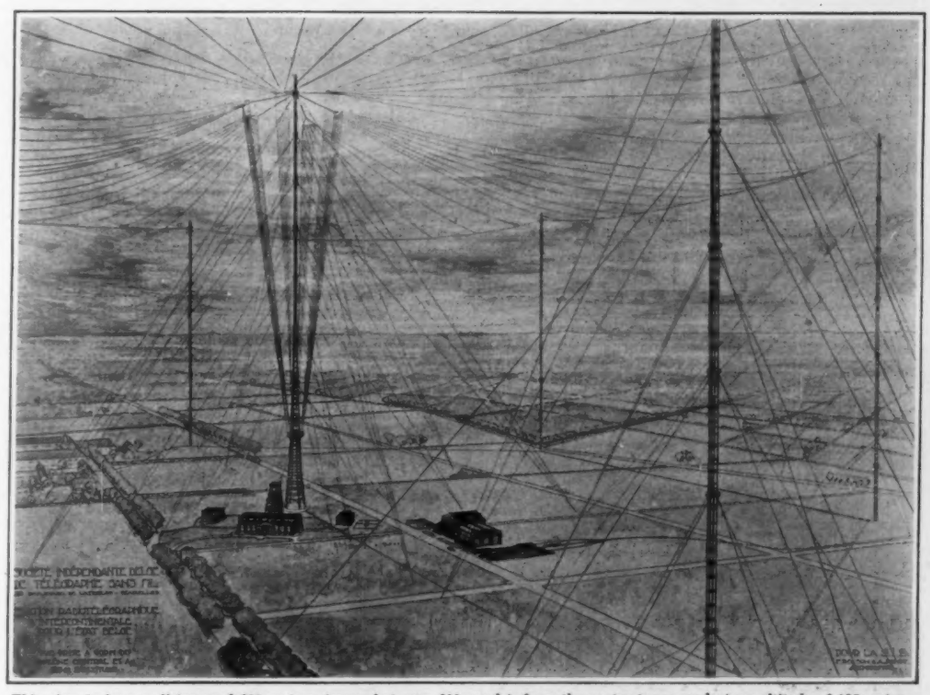
THE Belgian State has just started a great radio station at Ruysselede, near Bruges, in the center of the Flemish country that was the center of the four years of trench warfare. This plant is intended to communicate with the Belgian colony in Central Africa, as well as with North and South America. It will perhaps be the most powerful plant in the world.

The aerial is to be supported by eight towers of 275 meters height. The power plant will consist of one 1000-kilowatt generator, with two high-frequency generators of corresponding power. One of these will be an arc generator, weighing 8000 kilograms; the second will be a high frequency alternator of the Bethenod-Latour system.

The second of these will work at 2500 turns per minute, giving a peripheral speed of 170 meters per second for the rotor. It works in a partial vacuum to reduce the resistance. Rotor and stator are to be cooled by oil circulating under pressure. The length of wave in both instances will be from 20,000 to 25,000 meters; current on the aerial, 850 amperes. Automatic transmission at a speed of 100-120 words per minute will be employed.

The building of the plant has been intrusted to the same Belgian concern that is now engaged on the Belgian stations in Central Africa. This concern has been trying out a process of receiving and transmitting radio messages in the form of photographs and drawings, after a scheme invented by the Belgian engineer Carbonnelle. There are hopes that by this process the giant Belgian station at Ruysselede will be able to operate at a speed heretofore never attained in radio work.

The accompanying drawing gives a view of the plant with its huge aerial as originally designed, although some modifications of this design are under way. The arc generator and the high-frequency alternator are likewise shown.



This view is from a distance of 600 meters (somewhat over 600 yards) from the center tower, and at an altitude of 125 meters above the station level. Some modifications are to be made in the details shown by this drawing

General view of the Belgian radio station at Ruysselede

Reactions Obtained by Ultra-Violet Light

M. DANIEL BERTHELOT recently made a communication in which he set forth the leading points concerning his researches on ultra-violet light, he having devoted his attention to this subject for a number of years past.

The effect of light upon physico-chemical reactions is generally weak as well as slow. However, one of the effects which has been known for a long time is that which is exerted upon metallic salts in the presence of organic matter, this being in fact the basis of photography. More recently, it was noticed that the chemical effects of light became stronger as the vibration frequency of the rays is higher, and for this reason the ultra-violet rays have a great interest. These can now be produced in a very convenient manner by the quartz mercury-vapor lamp. M. Berthelot points out that the vibration frequency acts toward radiant energy to bring in the factor of potential, or the intensity factor, analogous to the part which is played by temperature for calorific energy. It is in fact known by Carnot's principle that the mechanical efficiency, or available value of energy, depends not only upon the quantity but also upon the quality of the energy. For this reason the chemistry of high temperatures has given new and unexpected results, especially in the way of decompositions at high temperatures. But what is interesting is that these reactions can be produced at ordinary temperatures under the influence of the ultra-violet rays. The extensive researches made by the author constitute the basis of a new branch of scientific work, that of effects of light or photo-chemistry at high frequency, which has a striking analogy to the chemistry of high temperatures, and in which the quartz mercury-vapor lamp plays the part of the electric furnace.

It is found that the ultra-violet spectrum can be divided into three regions. As known at present, the spectrum extends for about two octaves, commencing at a wave length of 0.4 μ (75 trillion vibrations per second) and corresponding to the last of the visible radiations, and ending at about 0.1 μ (300 trillion vibrations per second). But the rays of the last half octave, from 0.15 to 0.10 μ, are almost useless for chemical researches, as they are absorbed by nearly all known bodies, and even by layers of air of a few millimeters thickness. For this reason M. Berthelot proposes to divide the available spectrum into three zones sufficiently well distinguished by their properties. As the entire available spectrum has 1½ octaves, this makes one-half octave for each zone. The first half-octave, ranging between 0.4 and 0.3 μ (solar or initial ultra-violet rays) includes the rays emitted by the sun which pass through the atmosphere and arrive at the surface of the earth. They have the same chemical and physiologic action as the blue or violet rays, this being a tonic but not harmful on living beings, who are acclimated to these rays. Solar ultra-violet light can pass without difficulty through 1 or 2 millimeters of ordinary glass. The second octave lies between 0.3 and 0.2 μ (mean ultra-violet zone). These rays are injurious to life and have a sterilizing effect; they will pass through water, and produce numerous chemical reactions. Such rays have a catalytic action, and are agents of degradation of energy analogous to the ferments. The third half-octave lies between 0.20 and 0.15 μ, this being the extreme zone to be studied as yet. Like the preceding, they are injurious to life, but will not pass through water, while still traversing quartz. These rays produce various chemical reactions, and are classified as restorers of chemical energy.

The author established the following method for separating certain sets of the rays in turn, in order to observe the action of each. A large tank in quartz with parallel sides containing one centimeter thickness of distilled water, serves to suppress the extreme ultra-violet rays. If the water is replaced by solutions of chlorides in various proportions, this gives successive suppressions of the parts of the mean ultra-violet zone. Like separations can be obtained by using screens of very thin ordinary glass (0.14 mm.), mica, or the special "uviol" glass. A glass screen of 2mm. thickness will allow only the initial ultra-violet rays to pass through; these are the rays mentioned above which lie next the visible spectrum. However the mercury lamp is not needed here, for ordinary daylight will answer.

The most striking application made by M. Berthelot (together with M. Gaudechon) of the powerful effect of the ultra-violet rays consists in reproducing the fundamental mechanism of the restoration of chemical energy which we find in nature, i.e., the mechanism of chlorophyllian assimilation. When a mixture of water and carbonic acid is exposed to the rays, the first effect is a decomposition, and the carbonic acid now forms carbon monoxide and oxygen. But the carbon monoxide is an incomplete compound which always has a tendency to become saturated; it combines under the influence of these rays with the hydrogen which is also in the nascent state, and thus gives rise to the simplest of the hydrates of carbon, or formic aldehyde, which condenses and then polymerizes, producing the vegetable sugars. It will thus be remarked in what a simple way sugar which is the type of energetic aliments is produced at the expense of the carbonic acid and water vapor of the air. These experiments give a new aspect to the influence of luminous energy on the chemical biology of living beings. An obscure point still remains to be cleared up in this connection, for the reactions of synthesis which we just mentioned do not take place under the influence of ordinary light, but can only be produced by the ultra-violet rays. No doubt in nature and under ordinary light we must take account of the special reagents contained in animals and plants, such as the soluble ferments or diastases secreted by the living cell.

Other reactions of a very interesting nature can be produced by the rays, for instance the synthesis of quaternary compounds, using as a basis the inorganic gases of the simplest character and which are found most abundantly, for instance carbonic acid gas and ammonia. Under the action of the rays, a mixture of these two gases gives rise to the simplest of the quaternary compounds, or formic amide, which represents the starting point of the albuminoid or proteic substances, these being the basis of living matter. The ultra-violet rays have a great power of polymerization, and a high degree of concentration is at once reached. Thus when the rays act upon acetylene they do not produce benzine but a solid polymeric compound. In like manner, ethylene gives a waxy liquid which boils somewhat below 100 deg. C. and resembles caprylene. Gaseous cyanogen furnishes almost immediately solid paracyanogen. By these reactions the powerful effect of the rays is clearly evinced. On the other hand, the rays give rise to the reactions of oxydation with a very intense effect, causing for instance combustion in the cold of hydrogen, ammonia and cyanogen. In the presence of oxygen or simply of air, they produce nitrification in the cold of nitrogenous compounds.

Among other effects it may be remarked that the ultra-violet rays cause decomposition of most of the organic compounds. In the way of decomposition phenomena, analogous to electrolysis we now have *photolysis;* but while electrolysis is limited to certain classes of bodies and these under determined conditions such as in solution or in the melted state, the action of photolysis has a wide range. Concerning these latter effects, it is to be noted that bodies when exposed to the action of the rays will give off gases in a manner resembling what occurs in fermentation. To sum up, from the foregoing it will be seen that the ultra-violet rays afford a powerful source of energy, which at the same time can be easily handled and varied according to circumstances, and by its use we will be able to produce phenomena of a most interesting nature, some of which could not hitherto be produced outside of living beings.

Bicycle Tail-Lights in Great Britain

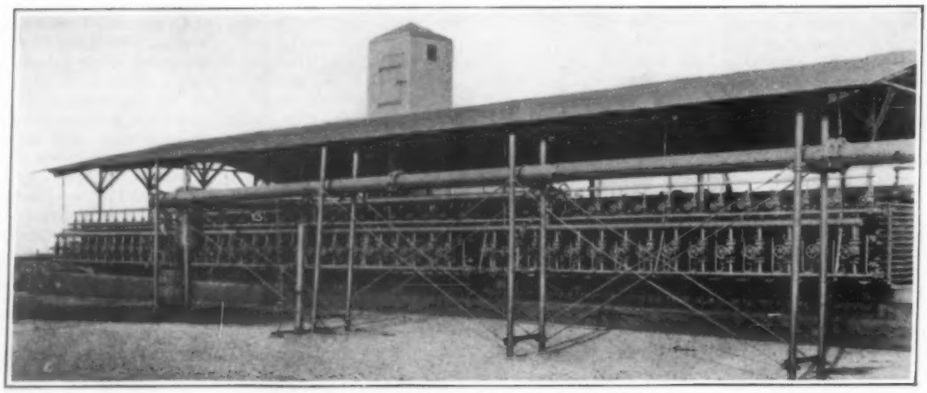
THE British automobile journals are giving much space to a violent controversy regarding rear lights for bicycles. The present law does not require these. Automobilists insist that all road users should be subject to the same requirement in this respect. The cyclists are violent in support of the thesis that the automobilist should light his own road for a distance within which he can stop, ignoring the obvious fact that a man on a bicycle reflects practically no light and is well nigh invisible in any headlight.

The Ice Cream Factory

How This Industry Has Been Taken Out of the "Domestic" Category

By William A. McGarry

UNTIL relatively recent years the manufacture of ice cream was in the class of the "home industry." It was carried on, as a rule, either as a side line in small bakery and confectionery stores, or in small plants with little mechanical equipment and correspondingly limited output. Ice cream was considered a seasonal dainty, profitable only in warm weather. But all this has been disproved in Philadelphia, which is just as famous for its ice cream as for its scrapple and cinnamon buns.



Condensers located on the roof of the plant

In that city today there is a two-and-a-half-million-dollar, six-story steel and concrete plant built solely for the purpose of manufacturing ice cream. Its present capacity, which is being enlarged, is 150,000 quarts a day, or enough ice cream to furnish a standard six-to-a-quart plate to nine hundred thousand persons. Ultimately the company operating this plant will be able to advertise "a million plates a day" and perhaps more.

Ice cream making as still carried on in the home for family consumption, in the small freezers sold by many manufacturers for that purpose, is a swift and simple operation. It consists of little more than mixing cream and milk, or condensed milk, with fruit and sugar, placing the milk in the freezer and turning the crank until the stuff hardens. But the work is not as easily done in a great modern ice cream plant. Contrary to the popular supposition that ice cream is "perishable," the fact is that the ingredients are actually "aged" for twenty-four to forty-eight hours before being frozen, and after that, with proper icing, the stuff will keep indefinitely without turning sour. A sour taste in the cream indicates either that the mix became sour before freezing through carelessness, or that the ice cream was allowed to become soft and warm enough for bacterial action to begin.

This particular plant is protected against both possibilities. Its freezing rooms are equipped to reach a temperature of twenty degrees below zero under normally cool conditions of temperature, which insures the ideal temperature for ice-cream-freezing purposes of five degrees below in the hottest kind of weather. Experience has shown that ice cream subjected to the more intense degrees of cold is not nearly as palatable as that frozen in from zero to five degrees below.

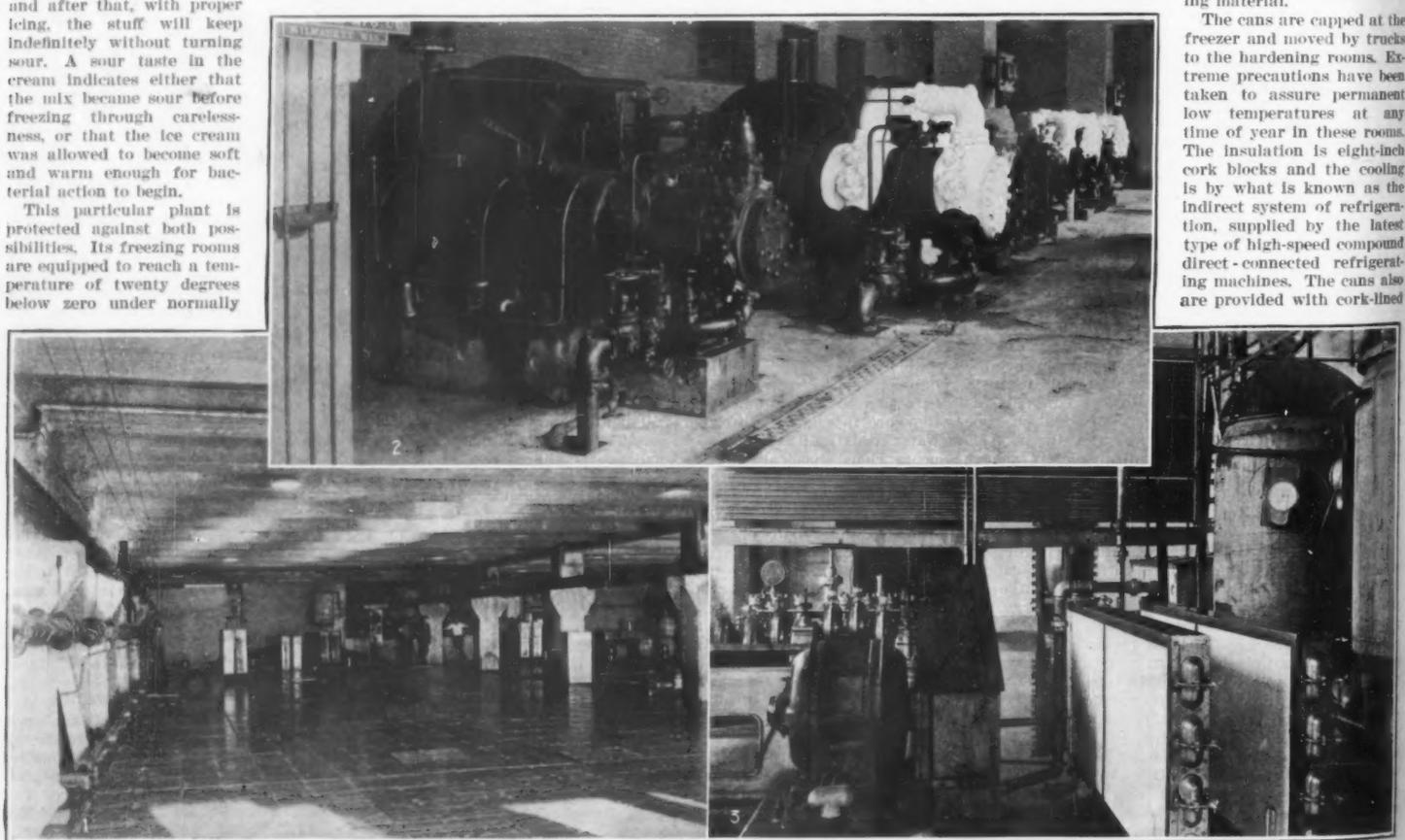
In this plant the practice is to use forty per cent cream, to which is added first the milk and sugar. Milk supply comes from many dairies in four states in order to eliminate danger of a shortage. When the milk reaches the plant it is pumped through a two-inch glass-lined pipe to the top floor, where the mixing process of milk, cream and sugar is performed in glass-lined pasteurizing tanks. From that point the mixture moves altogether by gravity until it passes from the final mixing machines or ice cream freezers into the large cans in which it is delivered to the dealer.

The first drop from the pasteurizing tank lets the mixture into a machine known as a homogenizer. In this it passes, under light pressure, through a series of discs that rub together with a circular motion similar to the rubbing of the palms. The purpose of this is to break up all the minute globules of butter fat in the milk and cream and to insure a smooth, velvety texture to the ice cream. So thoroughly does the machine do its work that these fatty particles, so essential to the food value of the ice cream, are completely distributed throughout the mass and never reunite.

From the homogenizers the mix is dropped again, this time to the glass-lined holding tanks, which are kept at cold storage temperatures. Here occurs the aging process. At the end of that period another valve is turned and the stuff drops again. There are fourteen 80-quart and six 160-quart freezers, large tanks containing paddles. The two-inch glass-lined pipe lines are equipped with feeders to supply these freezers. The fruit or flavoring is added at this point. When the mass begins to thicken slightly a door is opened in the front of the freezer and the thoroughly mixed ice cream slides slowly into the delivery cans.

Each of the mixing machines completes its work on a single batch in a little less than fifteen minutes, producing nine batches every two hours. The cooling medium is circulating calcium chloride, used instead of brine because it will not damage any metal parts with which it comes in contact. Each freezer is equipped with a double jacketed cylinder for the circulation of this cooling material.

The cans are capped at the freezer and moved by trucks to the hardening rooms. Extreme precautions have been taken to assure permanent low temperatures at any time of year in these rooms. The insulation is eight-inch cork blocks and the cooling is by what is known as the indirect system of refrigeration, supplied by the latest type of high-speed compound direct-connected refrigerating machines. The cans also are provided with cork-lined



1. Where the factory makes its own ice. 2. A group of refrigerator units. 3. Pasteurizing tank at the right, coolers in the center (the flat tanks), and homogenizer at left background

Some of the machinery of the ice cream factory

tubs in which they are iced for delivery. Cabinets supplied to the dealers are likewise cork lined.

Despite the fact that there is a very great length of two-inch pipe to keep at low temperatures, to say nothing of the freezers, the cold storage rooms in which the milk is stored to await pumping, the holding tanks in which the first mix is aged, and the cold storage rooms for the preservation of the fresh fruit in prime condition, the bulk of the refrigeration in the plant is used for the icing of the cans for delivery. For this purpose the plant is equipped to manufacture ice. With an output of 400 tons a day it is the largest single producer in the city, and fully 300 tons of this is used up in icing cans of ice cream.

Operating at full speed, the big refrigerating machines have a capacity of twelve hundred tons of refrigeration. But cold alone, even at the lower temperatures, will not make sanitation sure. Therefore in this plant, at the conclusion of a day's run, every piece of the glass-lined pipe through which the mix passes is taken apart, washed and left overnight in a cleansing solution. The same solution is used for washing the freezers, pasteurizers and homogenizers, as well as the cooling tanks.

Ice cream from this plant is sent to virtually all the New Jersey coast resorts and to many other points far distant from the city of its manufacture. In addition there are sixty-six delivery routes within the greater city limits. Cork-insulated bodies are made in a special department of the plant for the automobile trucks used for delivery. These bodies are water tight. All wood and metal signs, cabinets and tubs also are made within the plant so that there may be no danger of losing customers in a busy season through delay in the delivery of this kind of equipment.

When production is at its height tons of fruit pass into the plant every day, and out again in the form of ice cream. The handling of this must be surrounded with as much caution as that given to the milk and cream, and here again glass-lined, air-tight tanks are used to hold the fruit after it has been cleaned and crushed to the proper consistency for mixing. Crushing machines used are of types already familiar and in more or less common use. In making ice cream, however, it is necessary to have the mix absolutely smooth. The householder making it for himself will not object to large lumps of uncrushed fruit, but he is quick to protest if the commercial article is not smooth and velvety.

The ice cream habit apparently has taken a great hold on the American people, as the records show that its consumption is increasing year by year far out of proportion to the increase in population. This is doubtless due in part to the entrance of such companies into the field as that described here, in which a uniform standard of quality is reached and maintained at all times. Even in the winter ice cream is widely used in all the hotels and restaurants, and apparently it is coming into greater use every year in the home. It is given to athletes who have gone stale, as one of the quickest means of getting them back on edge; and doctors frequently prescribe or permit it to be given to invalids. When it is pure it is a food product of great value, and when it is made as we have described it can hardly help being pure.

Dr. Nimführ's Soaring Airplane

DR. RAIMUND NIMFÜHR, the Austrian scientist and inventor of the new type of airplane bearing his name, has recently published a number of articles on the subject of motorless flight. Dr. Nimführ calls attention to the difference between soaring, gliding and flapping flight, and shows that it is impossible to learn to "soar" by starting with a motorless glider. In flapping flight, the bird moves its wings up and down somewhat in the manner of an oar (like a pigeon or a crow), and when the motion of its wings ceases, we have gliding flight. When, however, a bird soars it holds its wings stretched out motionless, like a sail—hence the expression "sailing" or soaring flight. All the large seabirds and birds of prey, like the albatross, seagull, eagle and vulture, cover considerable distances in soaring flight; and in the middle of last century even scientists thought that the frigate bird spent most of its time in soaring flight, only settling for the purposes of breeding, while even today the coast dwellers of Borneo believe that the frigate bird lives on air. Audubon, together with other observers, claims the frigate bird to be the fastest flyer over the sea.

The three necessary conditions for mechanical and automatic soaring are safety from nose-diving and capsizing; that is to say, the airplane should not lose its equilibrium even when it is practically motionless in the horizontal direction, or when the rudder becomes useless in an air pocket. (2) The "lift" or buoyancy of the machine must be unimpaired even when it is traveling at reduced speed or when it gets into a downward air current. (3) A soaring airplane must be fitted with wings of variable size and variable angle of set, that is to say, the load on the planes or wings must adapt itself to the variations in the altitude of flight which take place periodically when soaring.

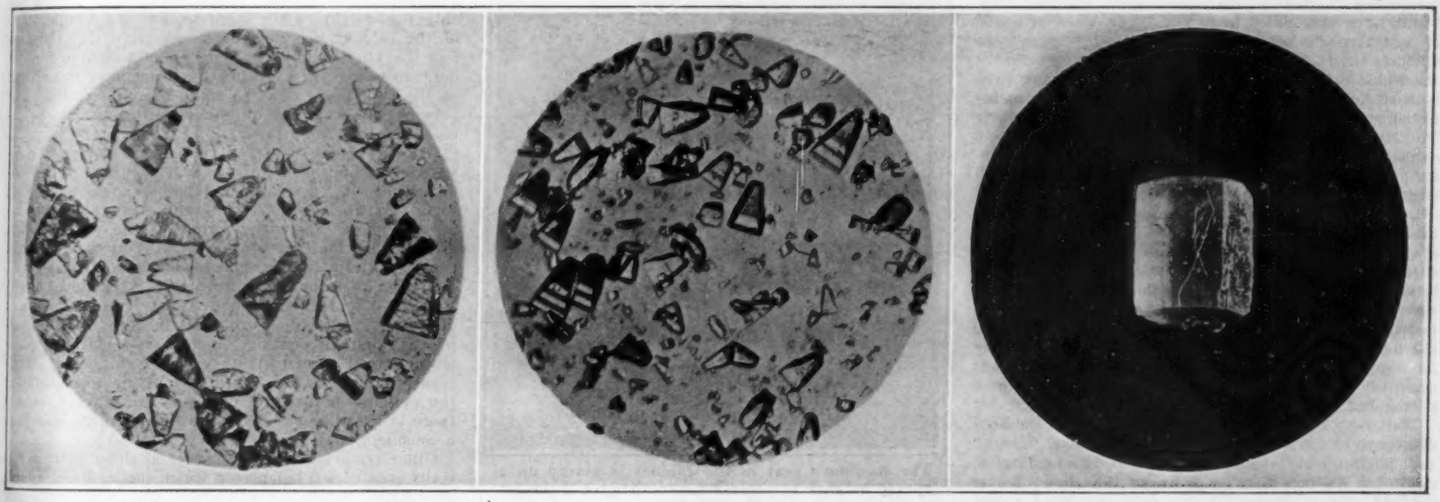
Dr. Nimführ's machine fulfils all the above requirements. To make it secure from nose dives and capsizing it is fitted with a number of "pressure-feelers" at different points. These pressure-feelers are nothing more than very sensitive aneroids or pressure gages which, instead of actuating a pointer, close an electric contact and set into motion servo-motors which in their turn automatically shift the wings slightly backward or forward as required, so as to reestablish the stability which may have been displaced by sudden sharp gusts or some other disturbing force.

The unique feature of the new airplane, however, is the pneumatic pulsating wings, which imitate to a certain extent, and mechanically, the swirling flight of certain birds such as the colibri (hummingbird), swallow, etc. In the case of the colibri, the number of wing-impulses are so great that the wings become practically indistinguishable. It was found impossible, however, to give this rapid pulsating motion to the entire wing of a mechanical flyer, so Dr. Nimführ conceived the idea of making the under wing surface pneumatic and pulsating. In the hollow space between the upper and lower wing surface are fitted airtight pockets, which are rapidly inflated and deflated by compressed air or the cooled exhaust gases of the engine, and so cause the wing to pulsate. These pulsations cause the under side of the wing to exert a compression impulse against the air strata immediately underneath, thus forming a sort of permanent air cushion on which the airplane rides. It is thereby possible for the machine to keep its altitude even in still air or in the descending branch of an air wave. Dr. Nimführ's airplane, which may be truly described as the most perfect transition between the airplane and the ornithopter (a machine exactly imitating the flight of the bird); further, it combines all the advantages of the airplane and the helicopter (the airplane which can ascend vertically and remain suspended by virtue of its vertical suspensory screws).

This new system of soaring flight opens up immense prospects of cheap and safe transport, as there are recognized routes where the winds are highly favorable to it. Moreover, the engine power required is but a fraction of that necessary in ordinary airplane flight.

Sandy Ice Cream

SANDINESS—crystalline texture and the presence of large, hard, fine gritty crystals like starch—has long been objectionable in commercial ice creams, but has never been explained previous to the conclusion of recent investigations conducted by H. F. Zoller and O. E. Williams, government scientists. These experts have isolated and identified the cause of sandiness as lactose and have carefully studied the growth of the sand crystals under the microscope. They have proved that the form of lactose appearing in ice cream is the normal "a" crystal—familiar to sugar manufacturers and chemists—which crystallizes from water solutions in tomahawk-shaped prisms and from protein solutions in more rugged or maize-shaped crystals.



Left: Isolated "sand" crystals from ice cream that exhibited this defect. *Center:* Pure recrystallized lactose hydrate from condensed whey. *Right:* A single crystal of pure sucrose. This is magnified five diameters; the two others, 90 diameters

Photomicrographic studies of the crystals in ice cream, which show the origin of "sandiness"

Ordinary mixes of commercial ice cream were made and placed in hardening boxes, the ice cream being repacked each day. On the fourth day, the fine, sandy crystals began to develop and subsequently were studied carefully day by day under the microscope. The general form of the crystals remained the same throughout the 20 days that the observations were conducted, although they increased greatly in size during this interval. Microscopic study was facilitated in each case by placing a drop of ice cream upon a glass slide and then viewing it through the microscope in polarized light. Subsequently, the sandy crystals were separated out by allowing some of the ice cream to melt at a temperature of 25 degrees Centigrade. It was then poured into large centrifugal tubes and centrifuged at 2000 revolutions per minute for 10 minutes. This resulted in all sandiness properties being concentrated in the sediment which could be studied under the microscope and subjected to various lactose and sucrose identification tests.

Samples of pure lactose and sucrose made expressly for this purpose in the government laboratories were also used for comparative purposes, and ultimately the chemical and dairy specialists found out positively that the lactose crystals caused the sandiness in ice cream. These conclusions are complete upsets so far as the dairying manufacturing industry is concerned, as the accepted theory was that sucrose was responsible for unavoidable presence of these objectionable crystals. The next investigational activities of the dairy scientists will be to ascertain satisfactory methods for the elimination of these sandy crystals from our popular frozen dainties.

Investigating Unknown Forces

The Unique Psychic Laboratory of Fritz Grunewald, at Charlottenburg

By Dr. Alfred Gradenwitz

TO an extent never witnessed in history, humanity is being pervaded by a Faustian craving for higher knowledge than modern science has been able to impart. More had been expected of physics and chemistry than they proved able to achieve. The secret of life was thought to lie closed up in their laws, and yet it was found that, while accounting for certain external phenomena in the world of organisms, they fail even to lead to the entrance door whence is disclosed the first glance at the innermost being of the organic.

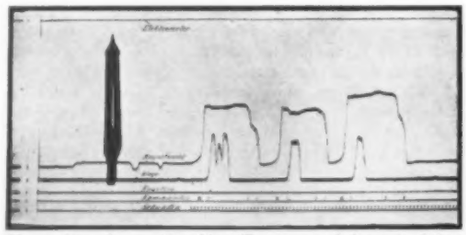
No, those forces which, behind the unceasing alternance of growth and decay, ever create anew the infinite variety of Nature's forms, those forces which are at the bottom of our own corporeal and psychic life, cannot be considered to be purely physico-chemical. Though all mortal creatures in their external behavior are bound to follow the physico-chemical laws controlling matter, the life-giving, driving factors are not to be sought in the world of phenomena accessible to our senses.

There would never have been a chance of obtaining any knowledge of that hidden world, but for the existence of human beings whose organic and psychic life occasionally passes beyond the border of what is considered "normal": "Witches" and "wizards" they would have been called in former times, when in honor of mistaken divinity, these exceptional beings were burnt at the stake; "media" they are termed by a more charitable era which—as a rule—knows no other punishment for them than public ridicule. Mediators between normal beings and a world inaccessible to their five senses, they often enough have to pay for their extraordinary gifts by an inadequate mental equilibrium and by hysteric caprices, all of which by no means facilitate experimental work with them.

Let us leave aside all intellectual manifestations and limit ourselves, for the moment, to a consideration of external phenomena. The validity of certain physico-chemical laws is apparent in many cases; it will be interesting to see whether *all* these phenomena are controlled by them, just the same as outside manifestations of the normal world. This, in fact, will be the first task incumbent on students desirous not only of acquainting themselves with the mechanism, but even of objectively proving the existence of these phenomena.

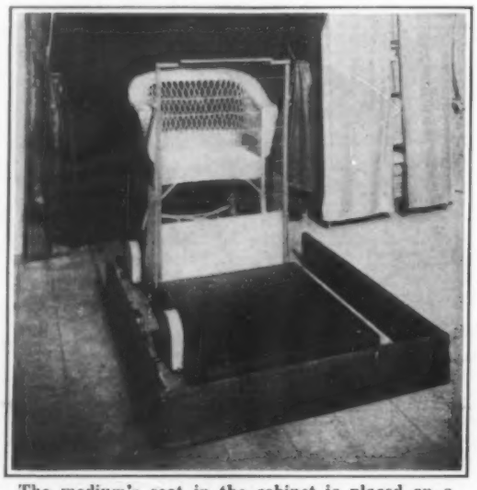
The use of physical apparatus has therefore been frequently suggested for the investigation of "occult" (or "metapsychic") phenomena. The famous English physicist William Crookes towards the close of last century was a pioneer in this field, while of recent workers on similar lines the late Dr. Crawford, as well as Dr. Baron von Schrenck-Notzing, of Munich, and Dr. G. Geley, director of the Paris *Institut Métapsychique International*, should be mentioned. Exceptionally efficient experimental outfits have, however, been developed by Fritz Grunewald, of Charlottenburg, who for many years past has been endeavoring to solve these problems with all the resources of modern experimental physics.

At the Psychic Research Congress recently held at Copenhagen, where the American Society for Psychical Research was represented by Dr. W. F. Prince, the great sensation was Mr. Grunewald's psychic laboratory, all the vital parts of which, on an invitation by Danish scientists, had been bodily transferred to the Danish capital. The pioneers of psychic research, meeting from practically all countries, were agreed as to the enormous possibilities embodied by these ingenious experimental outfits, and many arrangements for future cooperation with Mr. Grunewald were made.



The medium, by exerting his will, causes a balance to deflect and a magnetic needle to deviate; the records of the two phenomena are exactly parallel

A curve that records mediumistic processes



The medium's seat in the cabinet is placed on a spring balance to ascertain any changes in his or her weight

Inasmuch as certain phenomena are sensitive to light, the laboratory at its two windows comprises light-tight curtains, enabling perfect darkness to be obtained at a few moments' notice. The subject to be experimented on (or "medium," as she is termed) is seated on a chair placed on a spring balance, the deflections of which are transmitted to and recorded by a mirror galvanometer. The medium's chair stands in a cabinet.

At the opposite wall we notice the experimenter's table with a bracket over it; on the table is installed a large recording outfit for registering any deflection of the mirror galvanometer carried by the bracket. The lighting of the room (white and red lamps) is controlled from a switchboard; between the two windows there is an electrically illuminated time-piece, the brightness of which is controlled at will. At the wall opposite there is an instrument case; between the oven and experimenter's table there is a water supply and sink and at the side of it a water-jet pump. A chemical balance inclosed in a glass case is found on a bracket to the left of the table.

The medium's spring balance is intended to ascertain any change in weight she may have undergone during tests. In fact, the body of many media during sittings has been found to become heavier or lighter, the latter phenomenon ("levitation," as it is termed) sometimes being intensified to such a degree that the medium is kept suspended in the air. The balance is of extreme sensitiveness and enables these phenomena to be studied carefully. Another balance of the same construction is installed outside of the cabinet and is intended for certain phenomena of materialization to develop and be weighed upon. The two mirror galvanometers communicating with the balance will record their curves side by side on the same paper tape, thus enabling the connection between such phenomena and any change in the weight of the medium to be studied with the utmost care. A special arrangement even allows not only the weight of the medium, but the temperature of the cabinet, the degree of opening of its curtains and the kind and intensity of illumination and other data, to be recorded continually throughout the sitting on the same paper tape. A small red lamp enables any personal observations by the experimenter to be recorded on the same tape.

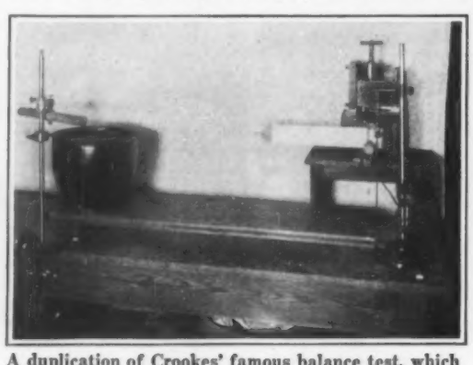
Grunewald has bestowed special interest on the investigation of some remarkable phenomena of *materialization*, viz., fluctuating, luminous vapors issuing forth from the medium's body and eventually condensing into more substantial forms. These were studied, at first with the spectroscope as to their wave lengths (colors), and afterwards photometrically, that is, with regard to their luminous intensity. A chemical investigation, likewise contemplated in spite of enormous difficulties, is likely to bring out the presence of phosphorus, thus accounting for the characteristic phosphorus smell accompanying work of this kind. Temperature readings were taken with a view to elucidating the well-known fact that at the end of psychic *séances* there is a striking coolness, as though there had been a consumption of energy.

Other remarkable results were obtained with a specially constructed balance on which the medium, merely by exerting his or her will-power, from a *distance* produces a *repulsion or attraction*.

Most noteworthy observations were made on the faculty possessed by some media of *deflecting the magnetic needle*. The body of one medium studied with especial care behaves like a system of magnet poles performing, it would seem, organic functions. In fact, a striking connection between this magnetism and physiological processes, such as breathing and digestion, has been brought out. Moreover, while the ferro-

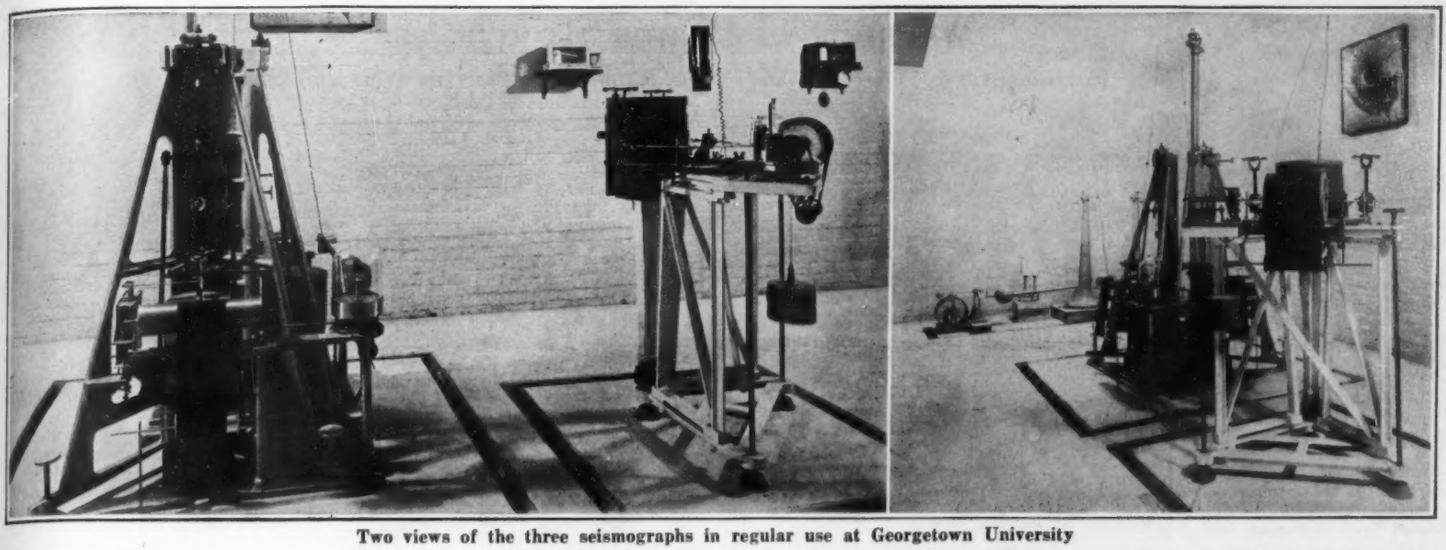
(Continued on page 70)

The balance test, in which the medium deflects the balance by willing that it shall deflect



A duplication of Crookes' famous balance test, which proves the existence of a psychic force

Measuring the electric conductivity of a luminous smoke issuing from the medium's hands



Two views of the three seismographs in regular use at Georgetown University

Earthquake Detection Near The White House

By George H. Dacy

IN order that all evidences of earthquake shocks which are perceptible in the vicinity of the District of Columbia, the private pasturing grounds of the presidents, may be registered, studied and interpreted, Georgetown University maintains and operates a seismological observatory under the direction of Professor Francis A. Tondorf. This station cooperates with the 336 other seismological lookouts that are scattered throughout the world whose objects are to keep tab on earthquake shocks and to determine the actual centers of each disturbance. Georgetown University also maintains a second seismological station at Guatemala, South America.

A peculiar condition developed at Georgetown University when the initial installation of seismological apparatus was made. It so happened that the sensitive and delicate quake-registering devices were first placed on the ground floor of South Tower which is 212 feet high. On account of the rocking of this stone and masonry tower during high wind storms, the seismological laboratory had to move to new quarters. A special cave was then constructed directly under the main quadrangle. This concrete cave is 12 feet 4 inches wide, 30 feet 10 inches in length and 11 feet high. It is provided with double concrete walls between which gas burners are constantly operated in order to make the laboratory as nearly damp and heat-proof as possible and to maintain an equable temperature of about 55 degrees Fahrenheit.

The present installation consists of three special seismographs, equipped, respectively, with horizontal and vertical pendulums. In a concrete building 159 feet above sea level some distance from the seismograph cave there is another laboratory where the photographic instrument which makes very accurate records of earthquake pulsations is kept. The time is registered automatically on the Georgetown seismographs by five contact clocks which accurately record minutes and hours, being corrected daily by signals from the Western Union Telegraph Company and the Arlington Wireless Station.

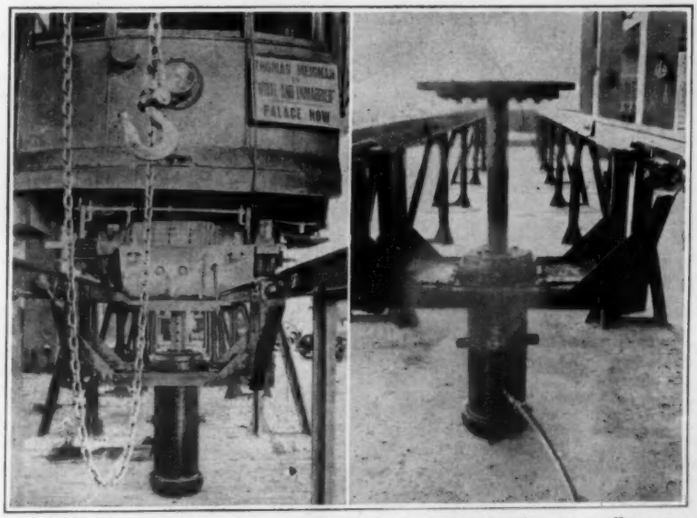
Professor Tondorf reports the occurrence of fewer earthquakes last year with an attendant decreased loss of property and life as compared with the previous year. "The year 1921 stands out as one of low seismicity," remarked Professor Tondorf in conversation with the writer. "Our seismographs recorded 61 earthquake disturbances in 1921 as compared with 68 in 1920. The latest records show that only 107 earthquakes occurred the world over last year. Of these, 77 were disturbances within the United States as compared with 98 earthquakes during 1920. Alaska and Hawaii, each suffered one quake last year, these disturbances being severe and of volcanic origin. Two of the shocks felt in Utah were very strong disturbances while the others observed in the United States were of little significance. It is improbable that any very pronounced submarine quakes took place last year as no abnormal tidal waves were observed by vessels which constantly ply the waters of the world."

By mid-summer, a new Galitzen seismograph will be installed at Georgetown University. It is now under construction in England having been invented and improved by a Russian scientist. It is a vertical seismograph which is provided with galvanometric registration which makes its records absolutely impervious to changes in the temperature. It will be the first seismograph of this type used in the United States. The fact that this new seismograph of this type is fortified to resist the effects of temperature changes on its registration is of great interest as, heretofore, temperature changes have caused considerable trouble with the recording operations of the types of seismographs now in use.

Some Physical Characteristics of the Ear

BY means of the audion oscillator, a special telephone receiver tuned to a high natural period and placed against the ear and a suitable circuit, numerous tests at various frequencies have been made on the minimum audibility current for normal and abnormal ears. From these data important conclusions can be drawn regarding the physical and physiological structure of the ear and also concerning the functioning of the ear and the auditory nerves with their endings as organs of hearing. If we define sensitivity as the reciprocal of the minimum vibrational energy in ergs of the receiver diaphragm that the normal ear can detect, then curves can be plotted showing the sensitivity as a function of the frequency. This has been done for a number of normal ears. It is to be observed that up to about 6000 cycles three distinct maxima of sensitivity are present; one at 900 cycles, one 1800 and another one at 3900. It is also important to observe that the sensitivity is much greater throughout the region from 200 to 4500 cycles than outside this range. Within this region are included all the frequencies which are of most importance for both speech and music.

The data also suggest the part played by the nerve endings, not as organs for changing mechanical energy into auditory nerve energy, but as organs which respond only to a very narrow range of frequencies where the pitch discrimination is good and which respond to wider ranges where the discrimination is not so good. Some curves were taken which showed that within a range of 100 cycles the hearing decreased suddenly so that the patients were unable to hear even though the vibrational energy of the receiver diaphragm was made 10,000 times as great as was necessary for them to hear at the lower frequency and perhaps 10^{10} as large as was required for a normal ear to hear at the frequency in question. With this amount of energy the region of the internal ear corresponding to the lower frequency was certainly vibrating with an amplitude considerably in excess of that necessary for audibility. Yet no tone was heard. In other words, apparently it would be necessary to stimulate the nerve corresponding to the higher frequency if the tone of the higher pitch is to be heard. Apparently a nerve will respond only to one frequency or a very narrow band of frequencies. The actual pitch determination, then, resides in the nerve endings which appear to have this highly selective action. It seems probable, then, that this work leads into fields which can be explored by precise physical measurements and which up to the present time have not been covered satisfactorily by other means of investigation.—*Abstract from article by J. P. Minton in the Proceedings of the National Academy of Sciences.*



The pneumatic pit jack in use (left) to remove a motor from a trolley car, and raised without any load. The second view shows the holes in the plunger through which pins are passed for safety when the jack is under load

Pneumatic Pit-Jack for Car-Repair Shops

IN the car-repair shops of an electric railway in Texas an interesting pneumatic pit-jack constructed in the company shops is used. The pits in the shop are of the open type and this jack is so constructed that it rolls on the inside of the rails which carry the car being repaired.

In using this jack the bottom half of the motor is lowered with the armature in it and is then pushed from under the car where the armature is then removed by swinging a jib crane over the track. By this method free access to the poles and field pieces is made possible.

The jack frame is constructed of 3-inch channel iron with 3/16 inch corner gusset plates. The wheels are ball bearings having pitted balls for which no other use could be found in the shops. The cylinder has a side adjustment of 12 inches and the plunger or push rod has holes drilled 1 inch apart so as to allow a ½-inch pin to be inserted at any height as a safety feature. The top has a minimum height of 3 feet, 2 inches and a maximum lift of 5 feet, 7 inches.

When Steel Beams Stretch

A New Instrument for Observing and Photographing Stresses in Iron and Steel

By P. J. Risdon

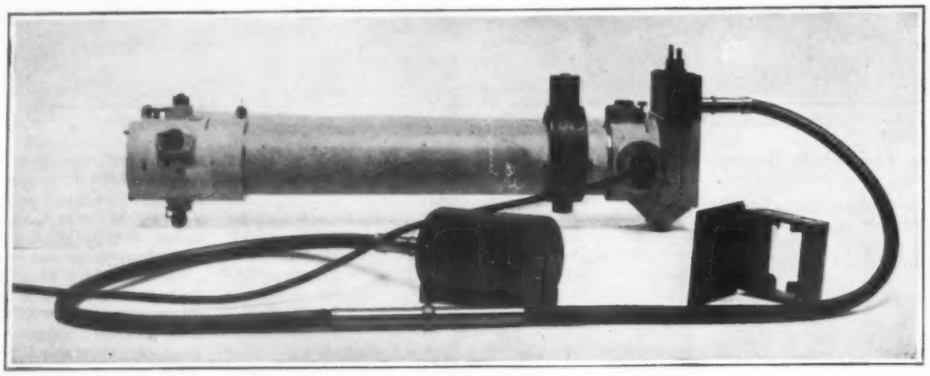
ONE of the (as yet) unsolved problems confronting the bridge engineer is to what extent his bridges are stressed by moving loads such as railway trains and road vehicles. The strains produced by the dead weight of a bridge and the flooring and ballast can be calculated, but with moving loads the conditions are entirely different. The speed of a moving train, the possible synchronization of forced vibrations produced by rolling loads with the natural period of vibrations of the structure, the unbalanced thrust on the driving wheels of a locomotive and the impact of heavily loaded wheels passing over rail joints, etc., all combine to enhance the effect of the mere weight of a train upon a bridge. In other words, when a locomotive weighing, say, 100 tons crosses a bridge it may produce stresses in the latter equal to those that would be produced by a stationary load of 200 tons or more.

It is quite impossible with our present knowledge to calculate with any degree of accuracy what the impact effect of rapidly moving loads amounts to for varying lengths and weights of span, and hitherto allowance has been made by the adoption of a more or less arbitrary formula to cover our ignorance on the subject.

One fact, however, is quite certainly known and that is that steel of a known quality and strength stretches or compresses elastically to a definite extent in proportion to the stress to which it is subjected, regaining its normal length when the force producing it is removed, providing that the stress does not exceed the elastic limit of the steel (about 13 tons per square inch). Of course, the extent of the elastic distortion is very small. At five tons per square inch of sectional area of the steel the stretch in a bar two feet long amounts only to about 1/115th of an inch. To deduce from such a small stretch what the stress amounts to requires either photomicrography or some method of magnification, and the inventor of the Fereday-Palmer stress recorder therefore set out to design an instrument which, by automatically magnifying the amount of stretch or compression of the steelwork in a given length, would record the actual corresponding stress per square inch.

This ingenious instrument, which has recently been put through extensive and satisfactory tests by the British Ministry of Transport and by the engineers of several of the big Indian railways, has thrown much light on the perplexing problem of the impact effect of moving vehicles on bridge structures. Although other types of stress recorders have been in use, the records obtained by them have been open to doubt, in many cases, owing to the inertia of certain multiplying levers and to the fact that the vibrations of the instrument itself become confused on the record with the vibrations of the structure under test. In the Fereday-Palmer stress recorder these objections are ruled out, the elastic movements of the steel under rapidly fluctuating stresses being magnified by a beam of light and recorded by means that will be described.

The instrument comprises a steel body-tube one-eighth inch thick, each end of which fits into a short casing. The front end casing is formed with a bracket below it, in which is set a pair of vertical screws terminating in hard-steel points capable of being pressed into any class of structural steel. In the rear casing is a vertical slot in which a specially shaped bar or "leg" is inserted, the lower end of which is fitted with a third hard-steel point. These three steel points form an isosceles triangle and, when the instrument is clamped to a bar or member of a bridge to be tested, the points are forced into the steel, so that any stretch or compression of the latter between the points lengthwise causes a movement of the vertical leg. Near its upper end the leg is reduced to a very small thickness to allow of elastic deflection and permit it to spring to and fro when the point moves. At its upper end it is tapered so as to fit tightly in a tapered hole above which it projects. There it is screwed and fitted with nuts for holding it rigidly in position. Where it passes through the bottom of the casing the hole in the casing is large enough longitudinally to allow of the small movement that takes place, but is a good fit in the other direction. A screw nut is provided so that when the instrument is not in position for a test the nut may be tightened and the lower end of the leg fixed. This nut is, of course, loosened when a test is being made. Within the tube a small mirror is attached to the leg in such a manner as to allow for adjustment. By the side of this is another mirror fixed to the case.



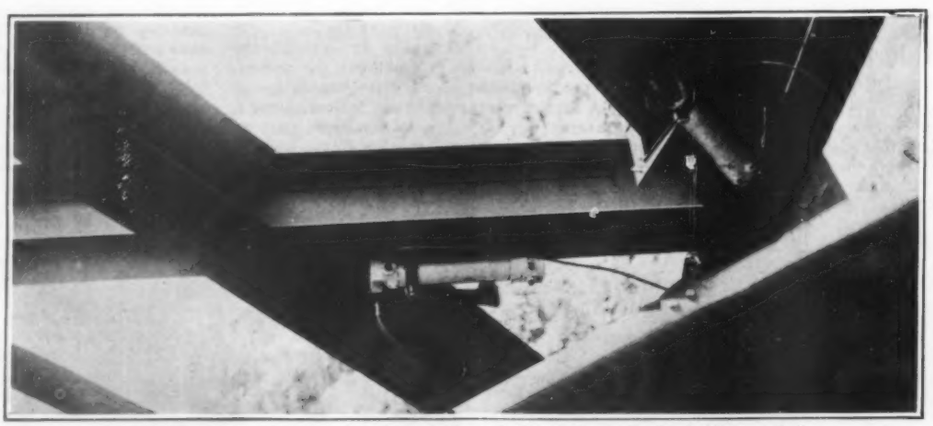
A general view of the Fereday-Palmer stress recorder

Inside the front casing, at the other end of the instrument, is a small electric lamp, similar to those used in electric torches, supplied from a four-cell portable battery. The light from this lamp, which may be varied in intensity by means of a resistance in the battery box, passes through a condenser in front of which is a diaphragm with a slit measuring 3/16ths inch horizontally by 1/150th inch vertically, through which light is cast on to each mirror which reflects the bar of light to the front end where a detachable cover with a vertical slit in it 1/150th of an inch wide is provided. These two spots of light, one fixed forming a base or zero line, and the other moving with the varying stresses, impinge against a photographic film which is drawn through, as described later, thus producing the record. When, however, stresses are to be observed, or when the instrument is being calibrated, the detachable cover is removed and a vertical scale substituted, across the divisions of which can be observed the bars of light. The reflected bars of light crossing this vertical slit result in two spots of light 1/150th inch by 1/150th inch passing through it. This latter fitting is graduated in 20 main divisions, each division representing a stress of one ton per square inch, thus giving a range of from 0 to 20 tons per square inch, or from —10 to +10 tons per square inch. Thus with every horizontal movement of the vertical leg in the rear casing, the mirror attached to it is tilted and the spot or bar of reflected light moves respectively up and down the slit or scale indicating the stress, whilst the other spot remains stationary at the zero position. When the recording spot moves upwards it indicates that the member being tested is under compression, if it moves downwards below the zero or datum line it indicates tension.

The instrument measures 20 inches in length between the steel points, so that it is obvious that a slight travel of the moving point is greatly magnified by the movement of the spot of light, the graduated scale being carefully proportioned to the length of the instrument and the length of the leg.

In a detachable box in front of the stress recorder is a pair of vertical spools, on one of which is wound a photographic film of a standard size, the end of which is secured to the other spool. Connected with the empty spool is a flexible shaft, the other end of which is coupled to a hand, or, if desired, a motor-driven winding gear. When photographic records are required, a stop-end is placed over the front casing, and whilst the spot of light moves up and down in response to stress fluctuations, the film is wound across it from one spool to the other.

In order to make sure that the lamp is burning, an inspection window is provided, beneath which another mirror, held normally in a horizontal position by a spring, may be lowered by pressing a button, thus intercepting the bars of light and reflecting them up to an eye-piece.

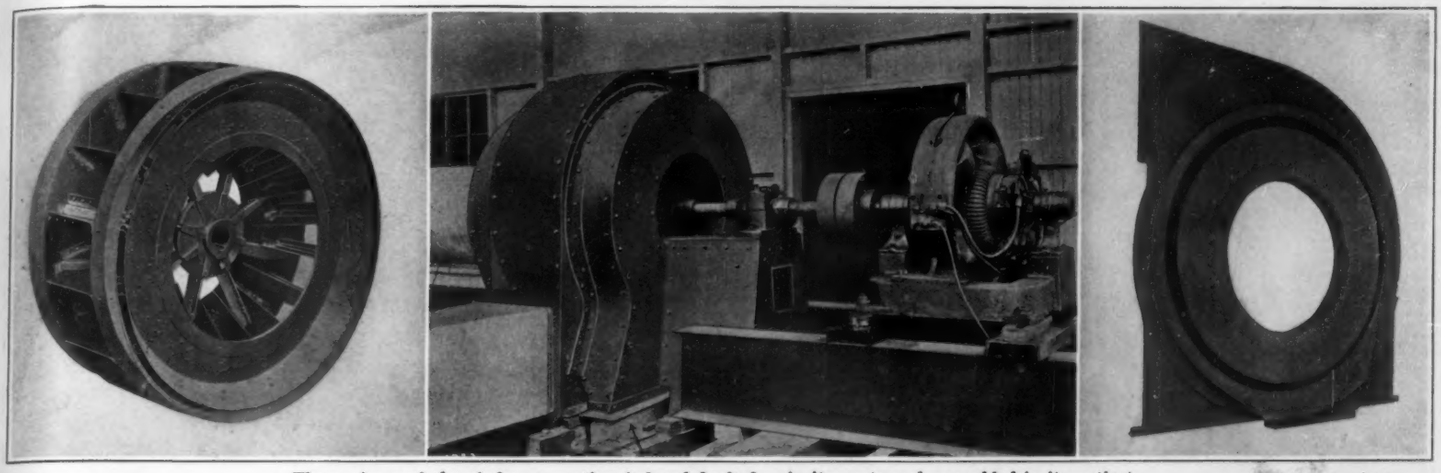


This puzzling picture is taken looking up through the steel-work of a bridge, and shows the stress recorder in position

Immediately before using the recorder, it is placed upon the calibrator. This consists essentially of a scale and a bar and spring supported on a rigid frame or base. One end of the bar is secured to the end of the frame, and the other end to a strong spiral spring. This spring is extended by means of a screw and hand lever at the other end of the bar until a pointer indicates 10 tons per square inch on the bar. At that point the stress recorder should indicate the same stress, the necessary adjustment to the mirror on the movable leg being made. After use, the recorder is again checked with the calibrator to make sure it has not got out of adjustment.

The instrument may be clamped to a member of a bridge girder or secured to it by drilling a small hole in the member and drawing the stress recorder tight up against it by means of a special nut, until the three hard-steel points are firmly embedded in the steelwork to a depth of about one-thirty-second of an inch.

Another important application is in the measurement of stresses in the hull and framework of a ship in a heavy sea—stresses which it is absolutely impossible to calculate. Readings may be made to within one-tenth of a ton per square inch, or, with care, to one-twentieth, as was done by the British Ministry of Transport.



Three views of the cinder-separating induced-draft fan, in its parts and assembled in its entirety

Catching the Cinders

IN 1916 an engineer of one of the large power companies in New York City issued specifications calling for an induced-draft fan which would at the same time act as a cinder separator. No quotations were received in answer to this request, as there was nothing of the kind on the market; but Mr. H. F. Hagen, manager of the research department of a leading concern, became interested in the problem and started to develop something which would serve the purpose. He was experimenting with a paddle-wheel fan, with the runner painted a bright red which was not completely dried. After the fan had been run for about two hours, it was noticed that the driving sides of the tees, rivets, and the inlet portions of the blades were coated with a fine dust. It immediately occurred to Mr. Hagen that here was an action sufficiently strong to separate cinders from the flue gases. This fan had been run in a research laboratory where the air was not polluted with any manufacturing process, and any dust which was in suspension in the air would be similar to that found in an office room. If a separation of such extremely fine dust was secured it seemed certain that the action would be successful with the very much heavier cinders.

The idea was then developed to provide buckets at the inlet edges of the blades of the paddle-wheel fan. There remained only the problem of disposing of the dust which was caught and separated by the wheel. This proved easy; inclined channels were provided leading out into the special dust chambers in the fan in which the dust could settle. Since it was impossible to blow the dust with air, as this would involve again a separation problem, it was decided to permit the dust to settle and fall by gravity into these dust chambers. The dust chambers lead to closed hoppers in which the dust is separated and from which it can be removed periodically or continuously by means of screw or other conveyors. From the view shown, it is easy to see the action of the dust in entering the inclined channels and thence to the dust chambers. Several little guiding vanes will be noticed which serve to direct the air and cinders into the inclined channels.

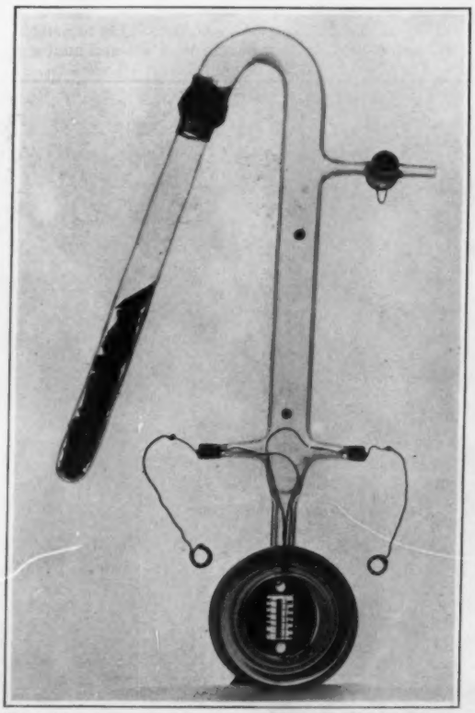
It was found that this cinder-separating fan could be built without taking up any more room and without requiring any more attention than an ordinary induced-draft fan. As a fan it proved more efficient than the average induced-draft fan in the market, and as a separator it was found, on test, to remove 75 per cent of the solid matter in the gases. Naturally the fan removes a much larger percentage than this of the heavy, coarse material which drops over the city in the neighborhood of the power plants, causing numerous complaints from the residents in that section.

Two large fans were installed in a large power plant in New York City and proved to be a complete success. These fans are installed in connection with six 500-horsepower boilers, and when these boilers were operating at 200 per cent of rating it was found that each fan was removing 250 pounds of cinders per hour, which showed on analysis some 9700 B. t. u. per pound. At higher ratings this would be much greater, and it was estimated that if these fans were placed on all of the boilers they would separate seven tons of cinders an hour.

The maintenance of these fans is practically negligible. The wheel will last as long as the wheel of an ordinary induced-draft fan because the latter is subject to the same abrasive action caused by the cinders against the blades. The housing of the fan will last longer because a part of the cinders never reaches the fan housing. The only place where there is any wear is in the cinder chamber of the fan housing. These cinder chambers are provided with easily removable wearing strips of simple forms.

The cinder-eliminating induced-draft fan is particularly desirable for use with underfeed stokers. The underfeed stokers do not cause a serious smoke nuisance as we usually consider smoke, but when they are operating the boilers at over-ratings, the necessary high forced-draft pressure blows a lot of the finer portions of the coal over into the stack and these are carried up and discharged over the city. The nuisance thus produced is very serious and is getting more so as boilers are being forced to higher and higher ratings. The extremely fine particles in the smoke are not particularly objectionable because they are carried away by the air currents and not deposited over the surrounding neighborhood, but the dust and cinders in the gases are fairly heavy and fall near the stack.

Many attempts have been made to clean the gases from boilers, but the success that has been attained up to the present time has not been sufficient to warrant a general installation of dust-removing devices. Usually an electrical system is an expensive proposition to operate, and involves a high investment. The washing of the gases, sometimes resorted to, gives fairly good separation, but the high up-keep of the washers and flue work handicaps this attack upon the problem.



Portable thermocouple that registers the infinitesimal amounts of heat which we receive from the stars

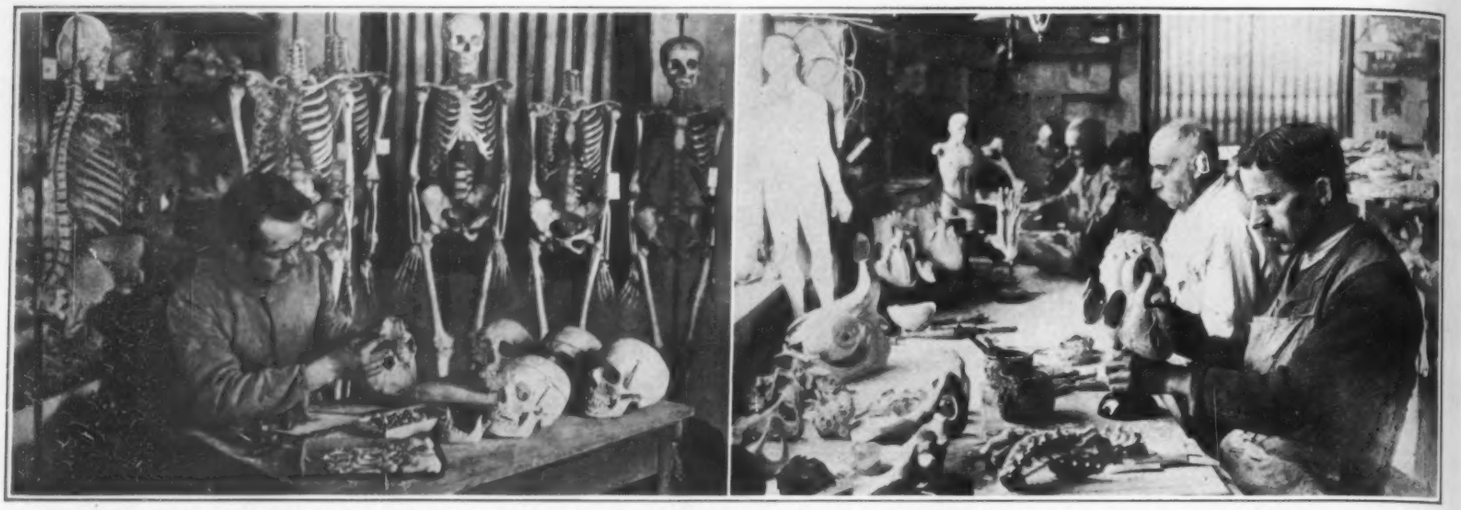
Measuring the Heat from the Stars

A PORTABLE vacuum thermopile of glass—a form of thermo-electric battery used as a thermometer in measuring the radiation of stars—has been perfected by W. W. Coblentz of the National Bureau of Standards. The empty space is maintained by use of calcium—a substance present in limestone and chalk—which has the faculty of mixing harmoniously with gases when it is heated. This device enables those engaged in determining the radiation of stars and sun to maintain a vacuum without being compelled to have the radiometer or measuring instrument attached to a pump.

The thermopile or radiometer is built of bismuth wire, 0.08 millimeter in diameter, and silver wire, 0.031 millimeter in diameter. When constructed of wire 0.1 millimeter in diameter the device would be less fragile and therefore better adapted to general use. The receivers of the instrument being described are made of tin, size 1.7 by 1.1 by 0.018 millimeters. The entire length of the receiver of the finished thermopile of a dozen elements is 12.5 millimeters; it has a resistance of 6.7 ohms. The bismuth wire, when cut to a prescribed length of 4 millimeters, is pressed flat between glass plates as a means of heightening heat conduction where it is in contact with the receivers. This facilitates the attainment of thermal or heat equilibrium.

The sensitivity of this instrument for measuring the heat of the stars is so keen, when exposed to radiation, that a galvanometer swing of two seconds is not retarded. Concretely expressed, when employing a galvanometer possessing a single swing of two seconds the sensitiveness of the thermopile is so quickly responsive that observations are not made with ease. To illustrate, 90 per cent or 18 centimeters of a total deflection of 20 centimeters is obtained in one second. The instrument in its new vacuum mounting, as shown in the accompanying illustration, is 20 centimeters in height. The mounting takes the form of a cup made of a single piece of glass, which is covered with a thick glass window. The quartz tube, a standard-size test container, holds the calcium and is cemented to the glass tube. The electrodes are of platinum wire 0.3 to 0.4 millimeter thick. Either an induction coil or a 200- to 10,000-volt transformer may be employed for testing the empty space.

The glass window enveloping the rear of the container is 7 millimeters thick. Considerable thickness in this particular is essential as a safeguard against warping by atmospheric pressure and resultant leakage through the ground joint. The latter is closed by use of beeswax and tallow. The lead wires to the thermopile are of copper, sealed to the glass with a platinum wire. The glass receptacle is mounted in a brass box, capable of sliding in vertical directions. The calcium used in the vacuum is cut into tiny pieces with a chisel and then inserted in the quartz tube, which is forthwith affixed to the thermopile container. The device is made void with an oil lamp. While the pumping is under way, the calcium is heated with a Bunsen burner as a means of causing this constituent of limestone and chalk to become identified with the water vapor, the air left in the container, and the acetylene gas which is generated from the water vapor and the calcium carbide, formed in preceding use. Pumping is continued for some time to clear the walls of the container of water vapor. The stopcock is then closed, and the vacuum is reasonably permanent.



Left: Fitting a set of false teeth in the jaws of a toothless skull. *Right:* The work-room in which large models of the individual organs are made; note the heart model in the foreground, with the invisibly hinged opening revealing the interior

In the shop where anatomical models are made

The Counterfeit Presentment

Anatomical Models — What They Are and Where They Come From

MOST of us have seen anatomical models of one sort or another, in class-room, museum or elsewhere. It is to be doubted whether the average person realizes, however, the variety of these to be had, or the variety necessary to give a complete demonstration of the entire human mechanism. There is, so far as we know, but one establishment in this country where the models in question are made—located in Rochester, N. Y. The majority of those which we see in use or on display come from abroad—and, of course, from Germany. The manufacture of articles of this character seems to appeal to the temperament of the scientific Teuton.

Some of the models are all in one piece, others come apart to facilitate study of the relationships which they portray; and still a third class comprises what to some extent may be called working models. Some of them show the entire human frame, externally or internally; some of them are of single organs or groups of organs.

Of those that involve the entire structure of the human body, there are numerous kinds. Those of us who have seen the general-utility anatomical model, with its blood-vessels in blue or red or both; its nerves in green, perhaps; its muscle tissue is still another color, and perhaps the skeleton or parts thereof in yet another, will probably agree that the general effect is confusing. Nevertheless, these general models are of great value as showing the structural relations between the several systems depicted. And many of them are surprisingly complete—there seems to be no end to the sections which can be lifted off to expose what lies beneath, or opened up to show what lies inside. One of our photographs shows the artist putting the finishing touches upon one of these omnibus models. This view gives a very good idea of the way in which the human anatomy is split up into layers by the modellist. In some regions the external layer is omitted altogether, in others it is present but detachable; and again it may be firmly fixed in place and not removable at all—as the side of the face and chest upon which the artist's brush is actually engaged in our view.

Aside from the general utility model of the entire human frame, there are those intended to facilitate special study of the circulatory system, the nervous system, the muscular system, etc. These usually are confined to the particular structure which they illustrate, together with such of the skeleton and general structure as is necessary to support and locate the parts which it is desired to show. Those especially which serve as three-dimensional diagrams of the muscles are prone to be liberally supplied with explanatory labels or captions, lettered on the surface of each muscle.

In addition to the general models, or "manikins" as they are often known technically, which show the entire human frame, there is obtainable a great quantity of special models of single organs or groups of organs. These are seldom sectional in the sense that they can actually be taken apart; but more often than not they are hollow, modelled true to life inside as well as out, and with a little door that opens and exposes the interior to the studious eye. Perhaps the most familiar of these single-organ manikins is that of the brain—everyone must have seen this one.

While occasionally the anatomical model is of plaster or allied material, usually it is so large that the weight of such construction would be a serious drawback. Most of these manikins are accordingly made of papier-mache. Their molding calls for a very considerable degree of artisanship, plus an anatomical knowledge running into details. Even more of a specialized task, however, is the finishing and coloring. This is artisanship combined to the last degree with art and anatomy, and it is not surprising to learn that there are few places in the world where it can be done properly. The photographs, showing in the one case a small model of a heart with all the delicate tracery of the outlying blood-vessels superposed upon it, and in the other the entire architecture of the abdominal cavity worked out in fullest detail, indicate sufficiently what an extremely delicate and fussy job this one is.

The work of the model maker is not wholly confined to casts and artificial models. For the perishable elements of our bodily structure we are of course dependent upon such counterfeit presentments for class-room and museum display, but our skeleton usually speaks for itself in the show room. There are, however, skeletons and skeletons; and not only do many of them have for some reason to be made good in some deficiency before going upon exhibition, but every one of them has to be articulated and mounted. This, while not such a highly specialized task as model-making, calls for considerable accurate knowledge of anatomy, and is usually done in the same establishment as the other work. Perhaps, next to the insertion of the wire supports that keep arms and legs quiet and ribs from sagging, the most frequent operation on skeletons is the supplying of the teeth which the subject has lost in life. Our gold teeth are admirable substitutes as far as mastication is concerned, but they are not exactly a valid base for the study of anatomy; so when we die under circumstances that put our skeletons in the hands of a museum or clinic, they are usually replaced by carefully constructed substitutes designed only to match in form the genuine article. Particularly is the grisly job of dental work done on skulls that are to be used as such—the dentition is such a very important part of skull anatomy that deficient teeth must be made good before such a specimen can serve any useful purpose.

A retoucher putting the "hair" on the head of a half-finished figure cast to life size

Novel Wire-Wheel Design

SOME time ago an American wheel maker perfected a wood wheel with a steel felloe in which the loose wedge was eliminated and fixed lugs securely fastened to the detachable rim used in its place. This type of wood wheel has been adopted by several quantity producers of motor cars. Now the fixed lug construction has also been applied to wire wheels. The same kind of steel felloe and the same kind of demountable rim are used, and the new wood wheel rims are interchangeable with the new wire wheel rims. The attached lugs on the wire wheels are said to do away with loosening of the spokes and with throwing the wheel out of round.

The Airman's Weather-Finder

AIRPLANE traffic between Britain and France has been greatly hampered by fog, that characteristic feature of British weather. It has often been impossible to start, or at least altogether risky to venture into the air, from the starting point at Croydon, even though reports from stations five or ten miles along the route showed clear skies; for no adequate information could be had of the extent and particularly of the depth of the fog.

Through the courtesy of the *Illustrated London News* we are able to show a clever, albeit extremely simple, apparatus, by means of which this uncertain and unsatisfactory condition has been entirely done away with. It is known that human hair contracts sharply on passing from damp to dry air. A group of toy balloons is sent up on a cord through the fog; and they carry a little device by means of which, through the stated property of human hair, a signal is given to those below when the top of the cord emerges into clear, dry air. This signal consists in the dropping down the cord of a metal ring.

The manner in which this scheme is worked out is no less clever than the general idea itself. The ring is held in place on the cord, when the instrument starts its flight by a trigger-like catch. Attached to the butt end of this catch is the hair, which passes over a little pulley-wheel that acts as a fulcrum, and then runs up for some inches through an open cage exposed to the weather. The hair is damp to begin with when the adjustment is made on starting the flight, and so long as it remains in the damp, foggy air it remains damp and nothing happens. When it reaches the clear, dry air above the top of the fog, however, it contracts; and by virtue of the purchase given it in its passage over the fulcrum, it drags the catch-off to one side and releases the ring. The latter is mounted around the cord on which the apparatus goes up, so that it falls, not freely, but down this cord. When it puts in its appearance at the lower end of this, the observers know that the top of the cord has emerged into clear weather; and, knowing how much cord they have paid out, they know how high the pilot must direct his plane in the search for fair weather.

It is contemplated installing this weather-finder at close intervals along the Paris-London route, in conjunction with radio stations. The pilots of the planes will then be advised at all times how high they must go at various parts of their journey to get clear weather, and, among other things, to avoid such accidents as the recent fatal collision in the fog. In addition, the uncertainty surrounding the question of whether a safe start might be made in thick weather would be resolved, and trips that are now lost could be made alike in safety and in comfort.

Clear dry atmosphere above the fog.
When the instrument, suspended to the balloons, enters this dry air, the human hair of the instrument contracts, thus causing the ring to be released and to fall down the cord to earth.
Rubber Balloons Filled with hydrogen.
Instrument
(a) Showing the Ring in the act of falling as the Instrument rises above the fog.
Fog Balloons ascending through the fog
Hair
Hair
Fog
Lever
Ring
Cord
Cord
(1) The Instrument used for testing the Height of Fog.
(2) Sending up the Fog Balloons with the instrument attached for testing the height of fog
(1a) When the air is heavily charged with moisture... Broken Diagram to show how a catch on the lever supports the Ring.
(1b) When the air is dry... Broken Diagram to show how the Ring is set free when the lever is operated by contraction of the hair
Details of instrument shown complete in Fig. 1.
Paris
Fog
Boulogne
Station, 5 miles from Croydon had reported "No fog"
Pilot from Croydon for Paris, rising out of fog at a height of, say 1,000 ft..
Below is Croydon Terminal enveloped in fog
Fog Testing Apparatus had given height of fog as say 1,000 ft.
Fog
Croydon had received favourable weather information by wireless from points along the airway.
(3) Diagram showing a possible use for the Fog Testing Apparatus where a pilot would be enabled to make a safe start from an air station enveloped in fog.

The details of construction and operation, and some of the suggested uses, of the latest device for sounding the thickness of fogs and locating the clear zone above them

Limestone, Quicklime and Hydrated Lime for Use in the Manufacture of Glass

CIRCULAR 118 of the Bureau of Standards, for sale by the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents per copy, considers the quality of lime to be used in the manufacture of glass.

The paper points out that different grades of lime are required for the different varieties of glass. Thus, plate glass requires lime containing a high proportion of calcium and magnesium oxides, while cheaper glasses make use of less pure lime.

In conclusion it is recommended that limes be divided into three classes containing 96, 91 and 83 per cent of oxides of calcium and magnesium. It is also necessary that the calcium oxide content shall not vary from day to day, the maximum variation permitted being 2 per cent. All of these figures apply equally to limestone, quicklime and hydrated lime, the percentage being calculated upon the nonvolatile matter of the material. Whichever material is used, it should be fine enough to pass a No. 16 sieve.

The Coloring Matter of Red Roses

AN examination of the petals of the red rose "George Dickson" has shown that the anthocyan pigment contained therein is the cyanidin glucoside, cyanin. It is present to the extent of about 9/10 per cent by weight of the dried petals, and exists in the petals as an oxonium salt (*i. e.*, in combination with a plant acid). A yellow glucoside sap-pigment also occurs in the same flowers, but beyond the fact that it has been shown to be capable of producing an anthocyan, by reduction, and that it is not a glucoside of the flavonol myricetin, it has been further identified, on account of the small quantity present.

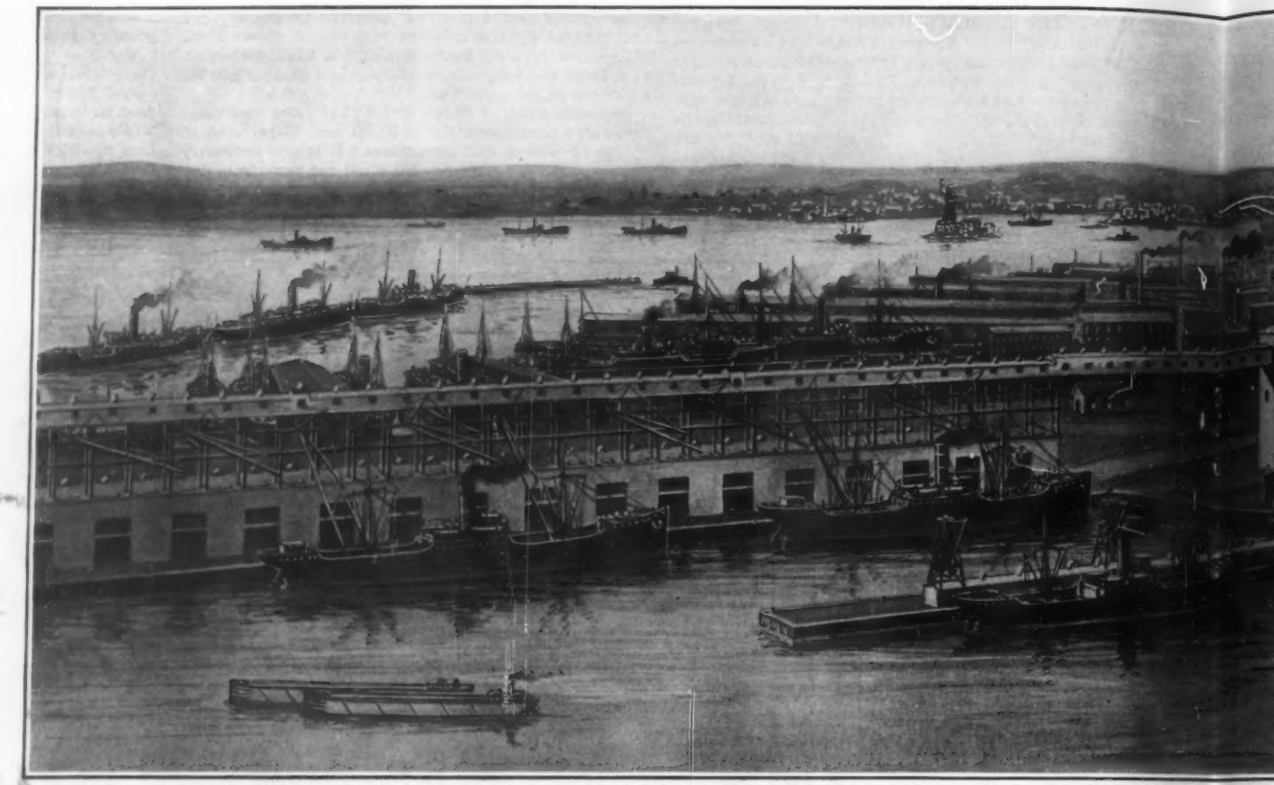
The rose "George Dickson" was chosen for this investigation on account of its deep red color, which would indicate a fairly large percentage of the anthocyan pigment.

One hundred grams of the petals (which had been first air-dried in the shade, at room temperature, and finally over concentrated sulphuric acid), were allowed to stand in a closed vessel, with about 300 c. c. of methyl alcohol, containing 2 per cent of concentrated hydrochloric acid (to prevent pseudobase formation), for about 24 hours; the mass was then pressed, to obtain as much extract as possible, and the residue treated with a further quantity of methyl alcoholic hydrochloric acid. After standing some hours, this was filtered, with suction, and as the extraction was still incomplete, the residue was again extracted with the same solvent. The residue, after filtering and washing, possessed but a pale pink color, and further extraction was deemed unnecessary. The filtrates and washings were united; they possessed a fine, deep red color, with a bluish-violet tinge at the edge of the solution. The combined filtrates and washings were poured into about three times their volume of ether, well agitated, and allowed to stand for some hours. Practically all the anthocyan pigment separated out as a dark brown, gummy mass, from which the supernatant solution could be readily decanted.

The crude anthocyan pigment was redissolved in methyl alcoholic hydrochloric acid, and reprecipitated with ether (about two and a half times the volume of the alcoholic solution). After standing some hours, to allow precipitation to be as complete as possible, the ether-alcohol solution was decanted off and the precipitate allowed to stand for 24 hours in contact with a mixture of methyl alcohol and glacial acetic acid (to remove impurities capable of being hydrolysed or acetylated), and finally collected on a filter, washed with a small quantity of methyl alcohol (containing 1 per cent hydrochloric acid), and air-dried.

The dark brown powder thus obtained was dissolved in boiling water, an equal volume of ethyl alcohol (containing 3 per cent hydrochloric acid) added, and the solution allowed to cool; the coloring matter separated out in the form of dark brown leaflets, possessing a golden reflex. These were collected and air-dried. For identification purposes the anthocyanin chloride thus obtained was examined for the following properties: viz., crystalline form, color and reflex; color changes on the addition of ferric chloride to aqueous and alcoholic solutions; color of solutions in aqueous acid and alcohol; color changes with alkalies; behavior with Fehling's solution (hot and cold); color of precipitate with lead acetate; and behavior with sodium bisulphate.

On comparing these properties with those given by Willstatter and Nolan for cyanin chloride, they were found to be identical; the anthocyan pigment of the red rose "George Dickson" is, therefore, the di-glucoside cyanin.—*G. Currey in the Proceedings of the Royal Society for March, 1922.*



General view of the two-million-bushel grain elevator, now completing for the State Barge Canal, showing its location in New York Harbor. To
Canal dock, and between elevator house and dock extend the covered-in b

The Terminal Elevator for

Built to Receive Grain from the Canal B
Deliver It to Deep-Sea

HITHERTO, in the few years of its operation, the State Barge Canal has labored under the great disadvantage that, when its barges laden with wheat reached New York, they were dependent upon the grain elevators of their competitors, the railroads, for receiving and handling their cargoes. The railroads naturally gave preference to their own trainloads of wheat, and the canal barges had to wait their turn, and were subjected to much costly delay. Consequently New York State has constructed the very fine concrete elevator, with its accompanying docks, dock-sheds, and covered conveyor belts, which is shown in our illustration. This great plant has been built in South Brooklyn, where it is conveniently situated to the main channel which leads into and out of New York Harbor.

The elevator itself covers a site 408 feet in length, and about 70 feet in width. Here, resting upon pile foundations, has been built up a great cluster of circular, reinforced-concrete bins, *W*, arranged three abreast. There are 54 of these circular bins, and by studying the plan-view it will be seen that they are connected with each other, both transversely and longitudinally, by vertical walls of concrete, which serve to provide between the circular bins a series of star-shaped bins, *Y*, of which there are 34 in all; while around the outside of the structure a series of curved segmental walls provide 38 small bins, *Z*. The circular bins have a capacity of storing 25,000 bushels each. The inner bins contain 16,000 bushels each, and the outer spaces have a capacity of 4000 bushels. The total capacity of the whole structure is about 2,000,000 bushels. The height of the bins is 95 feet, and the total height from grade to the top of the main structure is 110 feet. The walls of the bins are 8 inches thick, and they are reinforced circumferentially by flat bars of steel which vary in sections from ¾"x1¼" for the first 65 feet of height, to ⅜"x1" in the next 15 feet, to 1¼"x1" to the top.

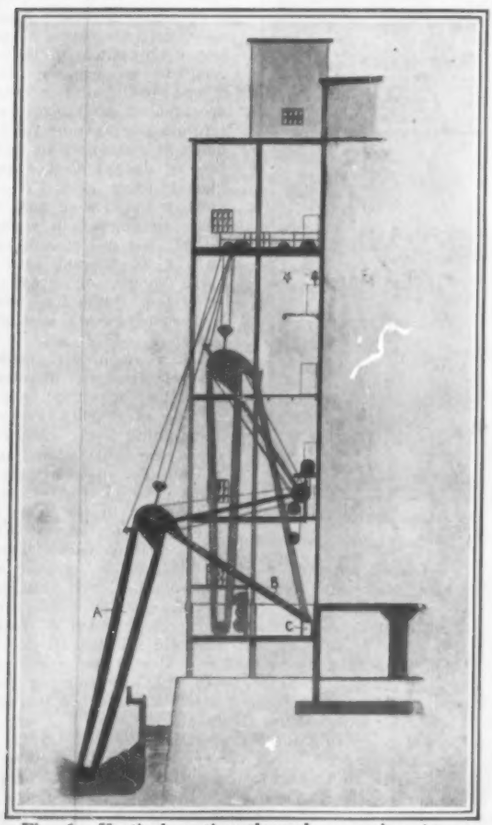


Fig. 1. Vertical section through a marine tower lofter, with elevator unloading a barge-load of grain

We are indebted for these details to Mr. H. G. Onstad, the engineer for the Fegles Construction Company, builders of the elevators, for the particulars of this great work, which, by the way, has been pushed through with remarkable speed. The concrete bins which constitute one complete monolithic construction were poured and carried to their full height between September 27 and October 9 of last year, or in 13 days of two shifts each. Continuous pouring at such a rapid rate was facilitated by the use of nearly 600 special steel screw-jacks, which supported the sliding forms, the latter being lifted steadily as the work proceeded. All the concrete materials were brought by barge to the site, where they were deposited in large piles. The mixed concrete was handled by two hoist towers, each 160 feet high, two bins having an aggregate each of 65 cubic yards capacity, and an extensive belt-conveyor system. Forty-two men were employed in wheeling the concrete to the top of the bins, and the total number of men employed was about 300. In addition to the bins and their equipment for handling the grain, there was built a large pier and freight shed, and a system of overhead belt-conveyors, which lead from the elevator house down to the extreme ends of the pier. The whole of this work will have been completed in about 12 months' time from the beginning of operations.

In our general view of this plant we are looking in a northwesterly direction. The barges are brought to the east side of the elevator house and moored alongside the marine towers, of which there are three; one at each end and one in the center. We present a cross-section of one of these towers showing a barge alongside, from which the grain is being removed. The grain is taken from the barge by what is known as a marine leg, "A" (Fig. 1), which consists of an inclosed structure within which runs an endless belt provided with buckets, which, as the belt travels, scoop up the grain and carry it to the top of the leg, where it is discharged into a spout, "B." The grain within the barge is brought to the foot of the marine leg by means of automatic grain shovels, which are operated by ropes led from shovel machines installed at the base of the marine tower.

The grain passes down the chute, "B," and is delivered to the boot, "C," at the foot of the marine tower lofter (Fig. 2); and here it is elevated to a receptacle known as a garner, "D." From the garner it is discharged by gravity to a garner, "F," from which it passes through a spout either to the main lofter legs, "G," which are directly opposite the bottom of the spout, or to a belt-conveyor, "H," which in turn discharges the grain to any of the seven lofter legs, which are placed at intervals down the length of the bins of the storage house.

The lofter legs carry the grain to the top of the cupolas, "S," of which there is one large cupola at the southerly end of the bins, which is served by five legs, and two smaller cupolas, one at the center and the other at the northwesterly end of the bins, each provided with one lofter leg. Our drawing (Fig. 2) is a cross-section taken through the bins and the main five-leg cupola.

When the grain reaches the top of the cupola it may either be discharged into the garners, "G," or be spouted direct to the bins within reach of this spout; or it may be

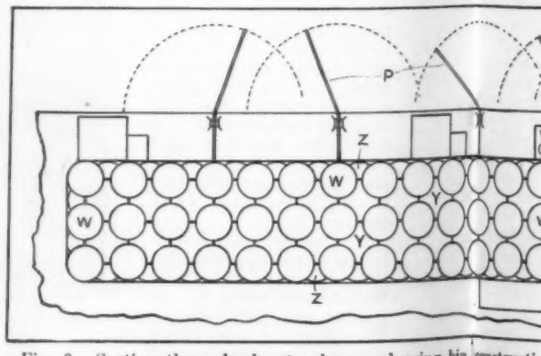
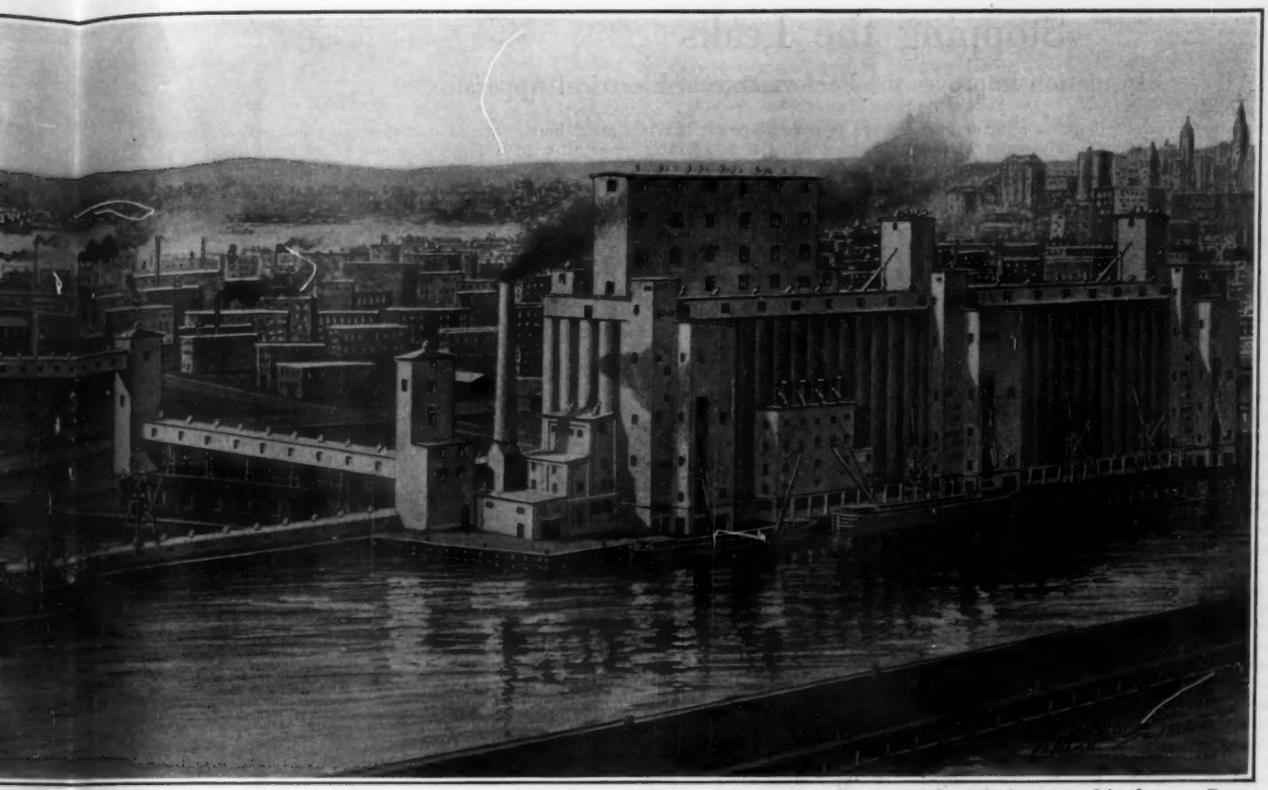


Fig. 3. Section through elevator house, showing bin
70 feet wide by 400 feet long, and 100

discharged onto belt-conveyors, "I," which extend for the full length of the house and can discharge it to any one of the 126 bins. It should be noted here that all grain is weighed before it enters the bins.

When the grain reaches the top of the cupola, "S," it is spouted to a large garner, "J," and from "J" it goes to a scale hopper, "K," where it is weighed; and thence it passes through spouts to the adjacent bins, or to the conveyor-belt, "I," as before mentioned.

Now, when the grain which has come through the barge canal reaches the lofter, it contains a certain amount of grain dust, and foreign material, such as mustard seed, oats, etc., and it is necessary to clean it before it is placed



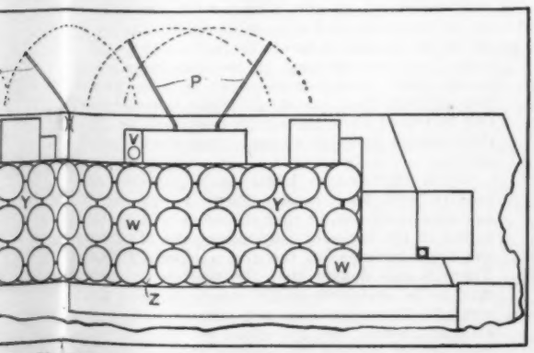
y York Harbor. To the right is the elevator house, with the tall buildings of Manhattan in the distance. In the left foreground is the new Barge end the covered-in belt conveyors for transferring the grain for shipment

vator for State Barge Canal

m the Canal Barges and Store, Clean and It to Deep-Sea Shipping

e house, cupolas, southerly and two r at the with one on taken it may spouted t may be

in the bins to await shipment. For cleaning, it is discharged to certain bins, "M," shown on the right-hand side of our drawing (Fig 2), which are sub-divided by a diagonal floor, the upper portion being used as a cleaning garner. From these garners the grain is spouted directly to four large cleaning machines which remove all the foreign matter, and discharge the clean grain through spouts to the lofter legs, "G," by which it is elevated and put back into the bins of the house. It should be noted that the uncleaned grain may be taken direct from the canal boats, or it may be taken from the storage bins in



wing bin construction and the five grain spouts. The structure, and 100 feet high, is built of reinforced concrete

for the any one ll grain "S," it goes to hence it the con-

e barge nount of rd seed, s placed

the house, as may be desired.

The foreign matter is spouted into sacks; stored on one of the floors in the cleaning house; and finally loaded into barges through what are known as the bag spouts.

The dust in the cleaning house is drawn off by suction fans; settled in a dust collector on the roof of the cleaning house; conveyed to a dust bin; placed in bags; and finally loaded to barges for shipment.

Now, since the grain, due to various causes, may become more or less damp, it is necessary to treat it in the dryer house. The dryer house, which is shown at the southwesterly end of the main building, is filled with vertical cylindrical receptacles, which are traversed by a large number of horizontal hollow pipes or ducts, through which a stream of hot air is forced under pressure. These ducts are freely perforated, so as to allow an escape for the hot air into the vertical drying cylinders. The damp grain is discharged by gravity at the top of these dryers, and as it passes down it is freely washed, if we may use the term, by the hot air issuing from the above-mentioned ducts. After discharge at the bottom, the grain is elevated and passed through a cooler, which is of the same general construction as the dryer, but with this difference—that cold instead of hot air is forced from the ducts into the grain, as it passes down. After being thus dried and cooled, the grain passes to the scale hoppers, where it is weighed and delivered to the lofter legs, which carry it up to the top of the bins for storage.

Along the northwestern side of the bin house are seven divided bins, the upper portions, "M," of which are used as shipping bins. From "M" the grain falls through spouts, "N," to the belt-conveyors, "O," which are housed within the elevated structures which extend from the great bin house to the end of the shipping pier. These belts are served by a series of shipping spouts, which are arranged at intervals down the full length of the deck. Through these the grain is spouted into the holds of foreign and coastwise ships.

From the shipping bins, "M," if it is so desired, the grain can be loaded through spouts, "P," on the easterly side of the house, either to barges or to the smaller seagoing ships.

Nutrient Requirements of Growing Chicks

YELLOW CORN (maize) is deficient in several of the essential qualities necessary for the complete nutrition of growing chicks. A deficiency in the ash content of the yellow corn kernel is no doubt responsible for the early failure by baby chicks when restricted to a ration of corn alone. Supplementing the corn kernel with 5 per cent of a complete ash mixture improved the ration so as to enable very slow but persistent growth.

Yellow corn is deficient in quality and quantity of protein required for normal growth of chicks. The addition of more corn protein by including corn gluten in the ration did not markedly improve the efficiency of the ration.

The addition of 15 per cent purified casein to a basal ration of yellow corn and ash did improve the ration decidedly. The amino acid deficiencies of the corn proteins are no doubt supplemented by the amino acid contributions of the casein.

Supplementing the basal yellow corn ration with certain other proteins, egg albumen, and gelatin, lowered rather than raised the efficiency of the ration. The poor results with rations 217 and 218 were probably due to a distinctly sticky physical quality which prevented normal nutrition.

The fat-soluble food accessory does not appear to be a limiting factor in a yellow corn diet for baby chicks. The addition of butter fat to a yellow corn, casein, and ash ration did not improve but rather lowered the efficiency of the ration. A slight change in the physical condition of the ration may explain this lowered efficiency, though it is more probable that the butter fat addition temporarily stimulated growth so that the supply of some other essential accessory was exhausted earlier than would have been the case had the butter fat been omitted. It is apparent at least that the failure of chicks on ration 215 was not due to fat-soluble A starvation.

Green feeds make certain very valuable contributions to a ration for growing chicks. The addition of wheat greens to a yellow corn, casein, and ash ration effected a decided improvement in the efficiency of the ration. An excess of the wheat greens was offered, and subsequent observations indicate that about 5 per cent (dry matter basis) of this kind of green food are consumed when offered regularly in excess. The helpful influence of the wheat greens may have been due to, first, an improvement of the physical condition of the ration; second, a food accessory contribution; third, an increased food consumption, due to a stimulatory effect on the appetite.

It is possible to raise to normal maturity chicks confined to a small pen. Drummond reports great difficulty in rearing chicks in confinement, and other investigators have noted some of the problems, especially leg weakness. *—Messrs. Jack Cecil Drummond, E. B. Hart, J. G. Halpin, H. Steenbock, in the Journal of Agricultural Research for October, 1921.*

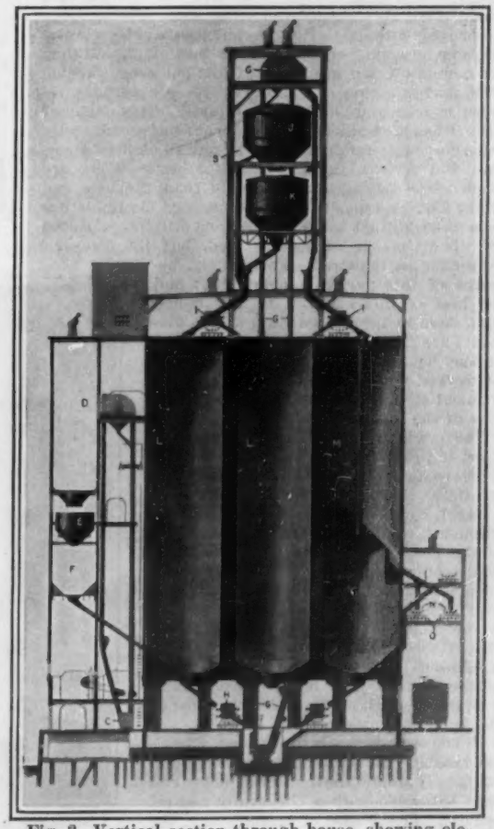


Fig. 2. Vertical section through house, showing elevators, belt conveyors, etc., for handling the grain

Stopping the Leaks

How Asbestos Insulation Improves the Performance of Electrical Apparatus

THE rated capacity of motors, dynamos, and transformers, so we are told, could be more than doubled by improving their insulation so that this feature of their makeup would be on a par with the other associated elements. This is certainly a significant statement; and realization of this desideratum would bring about a great advance in the art of practically applied electricity.

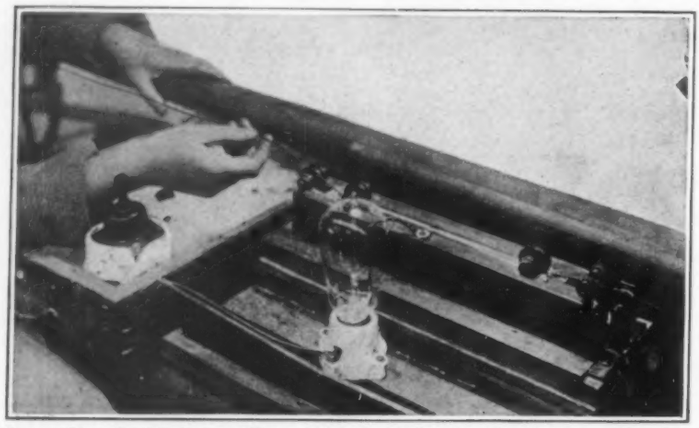
It is a matter of common knowledge among the electrical fraternity that the overload periods of apparatus could be much extended if it were not for the fear that the insulation would fail through the action of heat induced by overloading. The heat-resisting capacity of the insulating materials usually employed is generally taxed to the limit long before the temperature of a motor, for instance, has risen to the boiling point. It seems that a sustained or frequently recurring temperature in the neighborhood of 150 degrees Fahrenheit promotes carbonization of cotton tape, and this reaction transforms the insulating fabric from a nonconductor into a good conductor of electricity. The breakdown of the insulation invites damaging if not destructive short circuiting.

On electric railways, on many classes of machinery, on elevators, in rolling mills, in mines, and in numerous other departments of industrial life, the nature of the service demands frequent starting and stopping and the handling of loads of varying intensity. The sudden application of these loads produces heating, especially of the armatures, and this temperature mounts rapidly if the stresses are maintained for a while. The same handicap is laid upon the operation of lifting magnets, automatic switches, the windings of electric furnaces, solenoids, induction coils, transformers, etc. The betterment of insulation by the substitution of a material that can withstand high temperatures and still retain its dielectric properties is a matter of wide concern. Such a substitute for cotton, for example, would permit an increase of rated capacity, would safeguard against electrical collapse, and would effect very substantial economies.

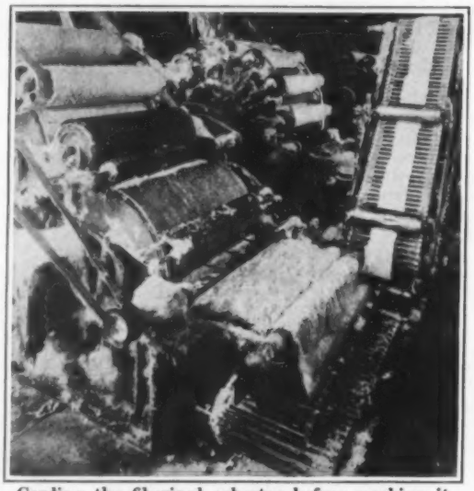
For some years, American technicists have been evolving, step by step, forms of asbestos insulation, and they are now producing insulators of this substance capable of replacing cotton or rubber wherever conditions require exposure to high temperatures. This state of the art has been reached only after extensive and costly experimenting; for from the very nature of their structure and physical characteristics asbestos fibers are much more difficult to manipulate than the long and pliant filaments of silk, flax, cotton, etc. Again, it has been essential that asbestos free from any traces of iron or other metallic oxides be used, lest its dielectric properties be impaired. Fortunately, asbestos of this purity is obtainable; and the best of this material is now mined right here in the United States. Its filaments are frequently three inches or more in length; and this permits the stuff to be worked up so as to insure ample mechanical strength and uniformity in thickness of the insulating envelope.

The crude asbestos is run through a fiberizing plant, where it is shredded and freed from particles of rock. After this treatment it comes from the machines in a light, fluffy state. Next, it is put through carding apparatus which comb all of the fibers out parallel to one another, and so prepared the mineral filaments are spun into a loose strand known as "roving." This roving is formed on a base of a few threads of cotton or silk; and should these materials oxidize after the insulation is in place, this deterioration of the textiles does not weaken in any way the strength or the dielectric value of the insulating asbestos.

When the asbestos is to act as an electrical insulator it is wound immediately and uniformly around the copper conductor, and then saturated with a chemically neutral cement. In the case of magnet wire, the impregnant not only binds the insulation to the conductor and renders it moistureproof, but it also gives the wire a finish that helps it measurably to resist mechanical abrasion. After this process the insulation is passed through rolls in order to smooth it and to make it uniform as to size. This is of very great importance in manufacturing magnet wire, as a variation of a few thousands of an inch one way or the other makes it unfit. The insulating envelope thus produced is guaranteed not to exceed in thickness the double cotton cover of a similar wire. There was a time when asbestos for this purpose was objected to because of the bulkier character of the insulation. The Navy has recently specified that asbestos insulated wire be utilized for the motors, etc., of a group of our newest submarines, where service conditions are very trying and the demands extremely exacting.



Inspecting, electrically, small magnet-wire insulated with asbestos. The wire passes through a mercury bath, and if there is any gap in the insulation, the mercury penetrates to the charged wire, closes a circuit, and lights the lamp



Carding the fiberized asbestos before working it into roving

Insulating heater cord with a covering of asbestos roving, on a machine capable of finishing 40,000 feet of wire per day

Magnet wire, whether round, flat or square, can be insulated in this manner with asbestos, and the envelope will hold its own even when the copper conductor is heated to the fusing point. The insulation can be heated quite 500 degrees without lowering its dielectric value; and it takes a temperature of 2280 degrees Fahrenheit to melt asbestos. Magnet wire, insulated as described, can be sharply bent without cracking or breaking the protective covering; and an elongation of 5 per cent is permissible.

In conclusion, let it be said that switchboard wire, nitrogen-lamp cord, heater cord for divers electrical appliances, moving-picture cables, and other cables that are led through hot places, are now to be had in which asbestos insulates against electrical leakage and the harmful effects of either heat or fire. American enterprise and ingenuity have made these commodities possible; and the net result is a long step forward in the direction of added efficiency and greater security in the use of electricity.

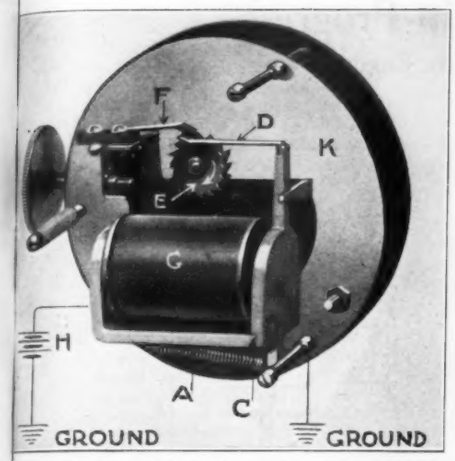
The Physiology of Grapefruit Ripening and Storage

AS a result of investigations made on the Physiology of Grapefruit Ripening and Storage, Mr. L. A. Hawkins of the United States Department of Agriculture concludes, in an article in the *Journal of Agricultural Research* for October, 1921:

"It has been brought out that in warm storage the percentage of acid calculated to the wet weight of the pulp increases markedly in two months' storage. There is evidence that this increase is not due entirely to loss of water from the pulp, but that there is an increase in the amount of acid present. There is evidence indicating that there may be a slight decrease in the sugar content in warm storage. In cold storage there is a decrease in the acidity very marked after four months in storage, while there is little change in the amount of total sugars present. A possible explanation of this difference in the behavior of the sugars and acids in warm and cold storage was pointed out. This phase of the problem deserves further attention. The investigations on the changes in the fruit during development on the tree showed that the total sugar content increased while the acidity decreased, the increase in sugar content being very marked.

"Fruit on the tree increases in palatability and food value. There is, of course, always danger that the seeds will sprout in the varieties containing seeds if the fruit remains on the tree too long. There is also danger that the fruit will drop or be shaken from the tree by high winds." These problems are common to all fruit-growing, and it does not seem that they should dictate the picking time of grapefruit more than of other species.

"It is of interest to note that the behavior of the acids and sugars during growth and in cold storage is similar to the behavior of these constituents of some of the deciduous fruits; that is, it is apparently possible to remove the fruit from the tree after it is well along toward maturity and to ripen it in storage. The result will be an apparently sweeter fruit, due to loss of acidity and a reduced bitterness, the naringin or bitter principle breaking down in storage. A period in cold storage, then, renders the fruit more palatable."



The mechanism of the battery-driven clock, that has no main-spring and needs no winding, running for a year without attention

A Clock That Runs Without Winding

FOR many years the bugbear of clock-makers has been the main-spring. Spring tension and spring driving power are of course greater when the spring is wound than when it is partly run down; and the regulator for this condition, to insure regular running at a uniform rate from the time the main-spring is wound up tight until it is completely run down, is the most difficult part of clock-making. And this is but the first drawback of the main-spring—there are others which might be mentioned, such as the necessity for using highly-tempered steel, which is peculiarly liable to crystallization and breakage when subjected to much vibration—which it gets when used on an automobile, for instance—and which, under this crystallization, deteriorates rapidly and to an extreme degree even when no actual break occurs.

We illustrate a clock, now on the market after some six years of investigation and development, in which the main-spring is done away with. The driving force is electric, and comes from the battery. The user of the other short-lived search-lights which have been on the market in recent years will be amazed to learn that the dry battery which comes with the clock is guaranteed to run it for a year. The reason for this is mainly that current is used, not continuously, but intermittently. At each tick of the clock the circuit is closed and the current flows for an extremely short interval of time; during by far the larger part of each second no "juice" is used.

There is no main-spring, and hence the clock is never wound. The timepiece is set, the battery inserted, and once the clock starts running and runs for a year. It can not run irregularly—so long as there is current to run it at all it must keep uniform time. The drawing shows the principles of its operation.

The spiral spring *A* pulls the armature *B* so that the driving pawl *D* drives the ratchet wheel *E* (a non-conductor) in the clockwise direction of the arrow. The driving pawl *D* and the holding pawl *F* press downward on the ratchet wheel *E*.

When this wheel turns through the length of one tooth the holding pawl *F* drops from the top of the tooth and makes contact, as shown in the drawing, with the driving pawl *D*, thus completing the circuit from the battery through the magnet *G*. The latter, energized by the connection, attracts the armature *B*, pushing the driving pawl *D* over the top of the next tooth in the ratchet wheel. *D* then drops to the bottom of the tooth, the pawl *F* being held at the top of the tooth and the circuit broken. With the armature released from the magnetic pull, the spiral spring *A* is then able to pull it over again, and the process is repeated.

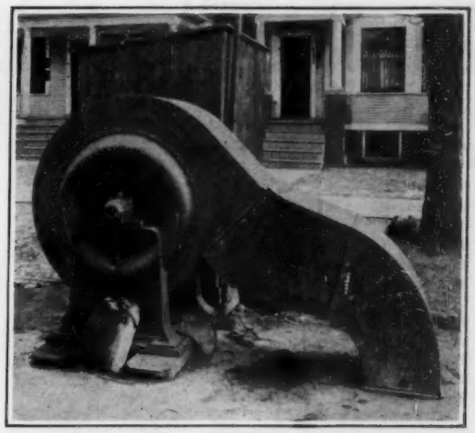
Making and breaking the circuit, which tensions spring *A*, takes less than one-fiftieth of a second, and it is only during this interval that current is used. The spring remains always under the same tension (save for the variation between tension and relaxation produced by the action of the current and the magnet); there is nothing to run down and no change whatever in the action of the clock from hour to hour or day to day. The current is either strong enough to overcome the spring, and work the clock; or it is not, and in this event a new battery is put in—once a year.

So accurate is the clock when run in this fashion that it is sold under an unqualified guarantee that it will keep time to the user's satisfaction.

Ventilating Manholes with a Portable Blower

IN Detroit the company furnishing electricity to the city has developed an interesting machine for ventilating manholes. When the temperature survey shows a hot duct run with temperatures of 150 degrees or over, this outfit is hauled to the vicinity and mounted over the manhole at one end of the hot duct run. The large vertical vent-pipe is inserted in a sheet-iron plate which is the same diameter as the manhole cover. The iron plate and vent-pipe are cemented together with asbestos cement so that an air-tight job will be attained. A ventilating cover is placed on the manhole at the other end of the hot run. This cover consists of a number of one-inch by one-half-inch bars spaced three-quarters of an inch apart and bound together by a circular band.

The blower has a 28-inch fan, and the power is furnished by a 7½-horsepower 220-volt D. C. motor mounted on a steel truck. Wires are strung to the nearest pole or wall-box, and when the blower is in motion a cooling current of air is forced through the ducts.



A portable outfit for blowing fresh cool air into manholes and electric ducts

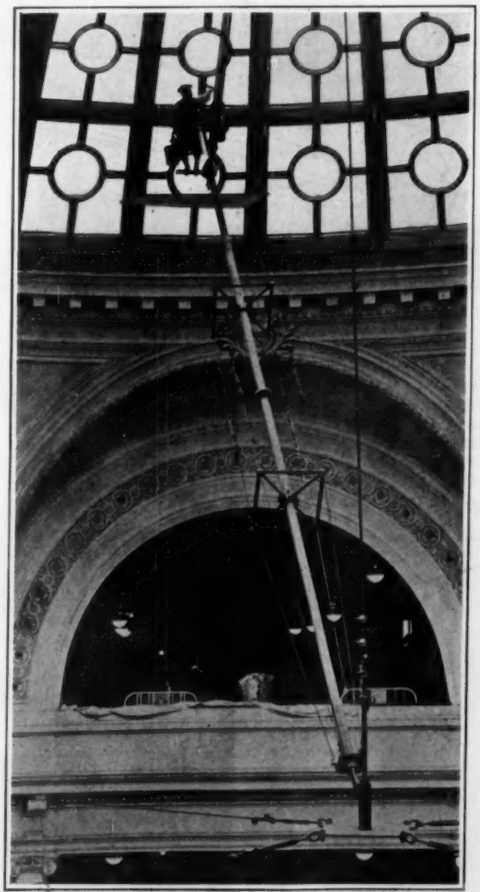
Optimum Temperatures for Flower Seed Germination

IN an interesting article in the *Botanical Gazette* for December, 1921, Mr. G. T. Harrington presents the results of experiments made to determine the optimum temperatures for flower seed germination. In conclusion the author says it is evident that the use of warm temperatures usually increases the rapidity of germination of the species investigated, but that comparatively low temperatures are more favorable for completeness of germination. In conducting germination tests of each species, a temperature should be used which is warm enough to accelerate the progress of germination as much as can safely be done. At the same time, it should not be warm enough to prevent the germination of any viable seeds, or to encourage more than is necessary the development of microorganisms.

When the germination temperature is too warm, frequently the germinated seeds make but little growth, and it is impossible to judge the comparative vigor of different lots of seeds. Sometimes weak seeds of little value will germinate when a warm temperature is used, and will then appear to as good advantage as other strong, vigorous seeds. If the germination tests are made with a more favorable temperature, both the strong and the weak seeds will germinate, but in this case the difference will be obvious at once. In this case some seedlings make rapid growth and are normal in appearance, while others have a watery, translucent appearance, grow very slowly, and sometimes have begun to decay before emerging from the seed coat. On the other hand, too cool a temperature decreases the germination, increases the time required, increases also the difference in time required by different lots of seeds of the same species, and thus makes uniform procedure with the different lots impossible.

In conducting germination tests of some seeds, considerable latitude is permissible in deciding upon the temperature to be used. With certain other kinds, as larkspur, the temperature requirements for completeness and rapidity of germination fall within narrow limits.

The substratum should be such as to furnish abundant water to the germinating seeds without limiting the supply of oxygen. For this purpose folded blotting paper well moistened with water is favorable. Most seeds of medium size can safely be tested between folds of blotting paper. Very small seeds do not hold the separate folds of the blotting paper apart so as to allow circulation of air between them. To insure a sufficient supply of oxygen, such seeds should be tested on top of the moist blotting paper. Candytuft seeds were tested on top of the blotting paper, not because of their size, but because of their mucilaginous covering, which softens when the seeds are wet and sticks the seeds insecurely to both the upper and lower layers of the blotting paper, thus increasing the danger of loss or displacement of the seeds when the blotters are opened to count the germinated seeds. Pansy seeds have a mucilaginous covering similar to the covering of candytuft seeds and may well be tested on top of blotting paper, instead of between blotters as in this investigation. Large seeds, such as sweet pea and nasturtium, should be tested between folds of moist canton flannel or other similar material, instead of in moist blotting paper, because the cloth folds around each seed and supplies moisture to a larger portion of its surface than the blotting paper does.



How five fixed points at the top and sides of the dome were made sufficient support for a painter's platform

Painting the Inside of a Big Dome Without Scaffolding

PAINTING, cleaning, or other work on the inner surface of a big dome has usually involved the erection of a large quantity of wooden scaffolding, at considerable expense and extreme inconvenience. The superintendent of one of San Francisco's big department stores, which boasts a large, dome-surmounted rotunda, met the problem in a novel and highly ingenious fashion. From the center of the dome he suspended a long and sufficiently heavy steel cable. At the lower end of this, where it hung in space, he attached four other cables, and stretched these taut in four directions to serve as guy lines. The picture shows this construction, and indicates that with the guys in place the cable is really a suspended pole, with ample rigidity. From its high-flung base a derrick-like arrangement was then swung upwards, carrying a comfortable seat for the workers, and supported further by lines to the top of the dome. The derrick-mast is sectional, and may be lengthened or shortened to permit of the workers reaching any desired spot on the interior of the dome.

How Airship Accidents Lead to Airship Progress

The Intricacies of Airship Design Explained by an Airship Engineer

By C. A. Oldroyd

THE world's largest airliner, "Z.R. II," the result of several years' hard work of the British Government's air experts, has come to grief. When executing turning maneuvers, the giant ship broke in two and, taking fire, plunged headlong to destruction.

The whole airship history is full of accidents; but one might say that it was these accidents that have made the modern ship what she is today, by riveting the attention of the designers to the parts which require still further improvements. The next ships were correspondingly stronger, swifter and safer.

What causes the wreck of an airship?

The causes may either lie in the ship herself, and be due to the breaking of essential parts of the structure, or they may be external, such as gales, thunderstorms or electric discharges which set the ship on fire.

The frame of a rigid airship is, after all, nothing but a giant birdcage which encloses the gasbags containing the lifting gas—hydrogen.

A number of very light lattice longitudinal girders (Fig. 2) run from bow to stern. Crossing them at right angles are the transverse girders. Between each two of the latter lies a gasbag.

Radial wires tie the structure together, and hold it to shape, just as the wire spokes of a motor car wheel hold the rim. The different bays formed by the intersection of the longitudinal and transverse girders are braced together by the so-called diagonal wires. Under them, close to the gasbags, lies strong netting, which transmits the lift of the gasbag to the framework.

Inside the ship is built a triangular keel, which contains a passageway affording access to the various cars, and to the fuel tanks and water ballast bags, which are suspended within the keel. But the keel serves another purpose. Strong wires run from the upper joints, D', C', B', etc., between each longitudinal and transverse girder, to the apex, N, of the keel (Fig. 1). They transmit the lift from these girders to the bottom of the ship.

This is necessary because all heavy loads, such as petrol, ballast, etc., are contained in the keel; the cars with the heavy engines are also suspended from the latter.

What happens now to our framework when the gasbags are in place and inflated?

The gasbag tends to escape from its prison and bears against the upper longitudinal girders and laterally against the radial wires. (Fig. 3.) The former must not only be strong enough to resist the pressure, they must, in addition, deal with the stress of compression, P, acting along their axis, due to the bending of the ship.

To deal with one load alone is comparatively simple; but to resist both together, without the girder getting too heavy and clumsy, is a much more difficult matter. You can make the experiment yourself. Take a thin twig and bend it slightly; if you add pressure on its end, it will tend to make the twig buckle or break.

If the next gasbag is also fully inflated, as under normal conditions, the two adjoining pressures counteract each other, since they act in opposite directions. But as soon as one gasbag is more or less deflated, as shown on the left side of the sketch (Fig. 4), the radial wires are forced out and a severe additional stress on the framework is the result.

Great as these stresses are, still greater occur when the ship is turning. With the rudders put hard over, the air pressure on the rudder planes forces the stern of the ship over, the vessel turns about her center while still proceeding on her way. Her path becomes a circle. (Fig. 5); we therefore speak of a ship's turning circle. Owing to the great length of an airship, her turning circle must be of larger diameter, modern large ships having turning circles of 1000 to 2000 yards diameter. The smaller the circle, the more violently the ship must be forced over, and the greater is the resulting stress and the danger of the structure failing.

While turning, the ship is also subjected to a powerful centrifugal force, which tends to throw the ship out, away from the center of the turning circle. The cushioning effect of the air counteracts this, as shown in the diagram (Fig. 5).

You all know the experiment of swinging a small weight fastened to a cord around in a circle; let the stone swing horizontally and you have the same conditions. The centrifugal force is in this case taken by the string (Fig. 6); in the case of the airship by the air cushion, which means another great stress on the framework.

And still another danger threatens our airship, the danger of fire. An electric connection breaks—a short-circuit happens—and if gas mixed with air is near, a mighty flame shoots up and the ship is doomed. But if the inside of the hull is well ventilated, so that no gas can accumulate, such an accident is very rare.

With the advent of the helium-filled ship, this danger will be eliminated altogether; but even in this case another danger still remains—the risk of the petrol taking fire!

Good petrol evaporates at ordinary temperatures, and as a large ship carries many tons of this fuel in from 20 to 30 tanks, a slight leak might easily occur, especially as the framework of an airship is not as solid as that of a bridge, for instance, and the structure "works" and flexes considerably.

The fuel is carried in large tanks suspended in the keel (Fig. 7), and from them pipes lead to the engine cars; first to a smaller service tank and from the latter to the carburetor. (Fig. 8.) A "backfire" from the engine, a short-circuit of the magneto, might ignite a few drops of fuel which have leaked out; immediately the fire would spread, first to the service and then to the storage tank. In a few seconds the whole ship would be on fire.

Only a new type of engine using heavy fuel would do away with this danger, and such engines are actually being constructed and tested in Europe. They possess a second advantage, they are very cheap to run, an important point in commercial aviation.

The rigid airship took 20 years to develop to its present state of perfection; a few years' work are yet required to produce the ideal long-distance aircruiser—the helium-filled dirigible, propelled by heavy oil motors.

That we shall ultimately reach that ideal, the writer is fully convinced. The results which have been accomplished in America in the production of helium, coupled with the certainty

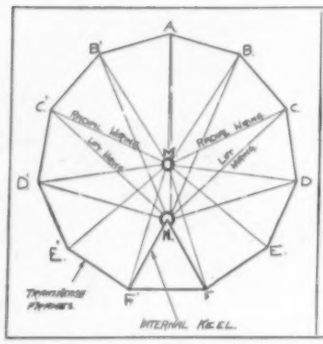


Fig. 1.—Radial wiring holding the frames to shape. Lift wiring transfers load to points D' C' etc.

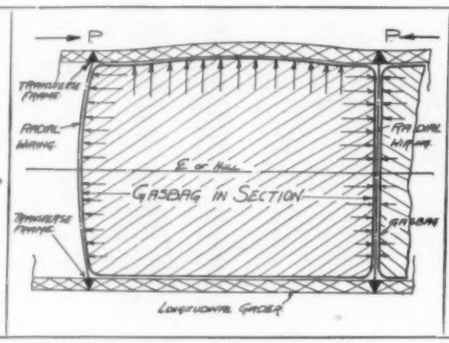


Fig. 2.—Note the tendency of the gas pressure to bend, outwardly, the upper longitudinal girders and the radial wires

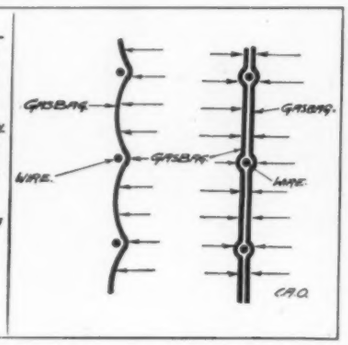


Fig. 3.—Arrows show effect of balanced and unbalanced gas bag pressure on the wiring

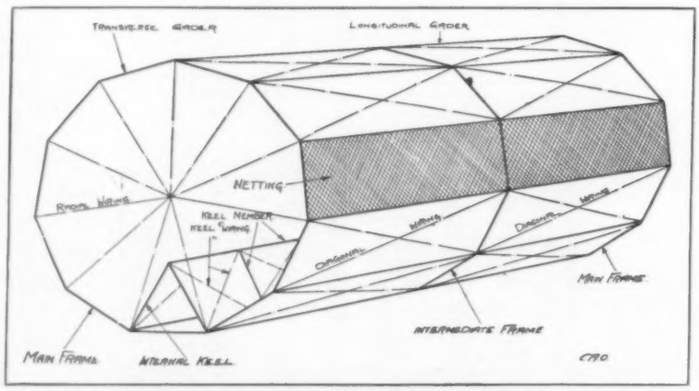


Fig. 4.—The framework of a rigid dirigible. Full lines show rigid compression members; dotted lines show wire tensional members

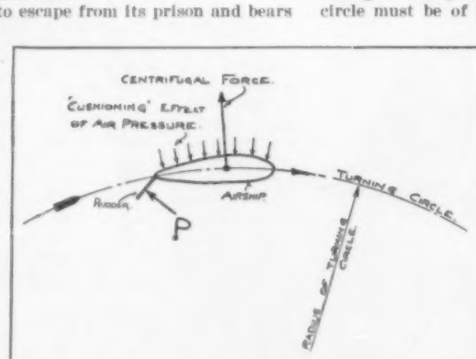


Fig. 5.—When a rigid is turning, centrifugal force is counteracted by air pressure on its outer side

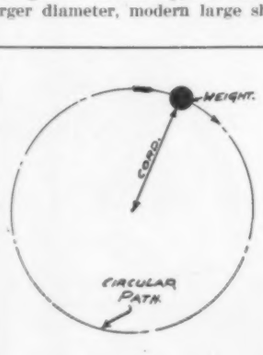


Fig. 6.—Centrifugal force of weight is taken by the cord, as indicated here

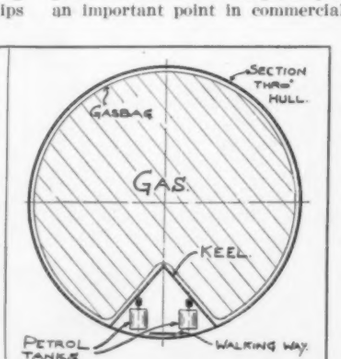
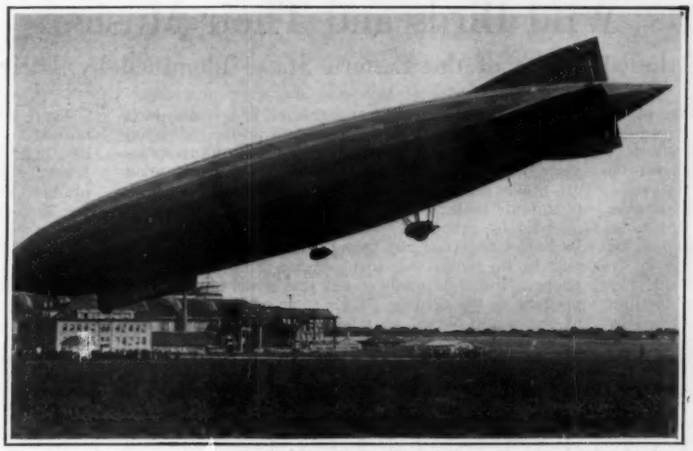


Fig. 7.—Cross-section of rigid dirigible, showing a completely filled gas bag and the fuel tanks

that improved methods will result in lowering its cost; the great amount of engineering talent which is being applied to the problem of producing a lighter heavy-oil engine; and the ever accumulating fund of experience which is being gathered from the operation of airships, under all possible conditions, make it certain that, earlier perhaps than many people expect, traveling through the air in comfortable, fast, and absolutely safe airships will be an established fact.

In considering this question we must endeavor to maintain our sense of proportion and prospective. If we feel dismayed over the loss of the "ZR-2" we must not forget the superb performance of her younger sister, "R-34," when she flew without mishap from England to America, and back again; nor the earlier feat of the German Zeppelin, which, in an endeavor to relieve German forces in Africa, made an even longer non-stop flight. These things have been done, and they give promise of even greater performance in the near future.



The old and dangerous method of landing which led to many wrecks. Today the rigid makes fast to the top of a lofty military mast

Conductivity and Permeability in Living Matter

PROFESSOR W. J. V. Osterhout of Harvard University presents an important article in the *Journal of General Physiology* for September, 1921, on Conductivity and Permeability in living matter.

When an electrical current passes from a salt solution into a living cell, says Professor Osterhout, ions must enter the protoplasm. An increase in the permeability of the protoplasm to ions must decrease its electrical resistance, and *vice versa*. The electrical resistance of the protoplasm may therefore be regarded as a measure of its permeability to ions.

If we attempt to measure the electrical resistance of the protoplasm we must first consider the structure of the tissue. For example, we find in the case of *Laminaria* that the protoplasm of each cell forms a thin layer which surrounds a large central vacuole filled with a cell sap. Since experiments have shown that the cell sap has about the same electrical resistance as the solution which bathes the cell, it is evident that when the electrical resistance of the cell increases, on transferring it from sea water to another solution of the same conductivity, the change must be due to an increase in the resistance of the thin layer of protoplasm which bounds the cell. This led the writer to assume that the resistance is proportional to a substance, M, at the surface of the cell; if M forms a layer at the surface it is obvious that an increase in the thickness of this layer will increase the resistance, and *vice versa*. It is therefore assumed that the resistance depends upon the amount of M which is present in the surface.

In *Laminaria* the protoplasmic masses (cells) are separated from each other by a thin layer of gelatinous substance (cell wall). In passing through the tissue a part of the current goes through the protoplasm and another part passes between the protoplasmic masses, in the substance of the cell wall. Consequently when we employ the electrical method we must ascertain whether we are investigating the permeability of the protoplasm or merely that of the cell wall.

Obviously the best method of attacking this problem is to kill the tissue by such means (e.g. partial drying, heating to 35° C., weak alcohol, etc.) as can not alter the cell wall, and then investigate its behavior under the influence of various reagents. We find that all of these methods produce the same result. After death the living tissue no longer shows the changes in resistance which are observed when living tissue is subjected to the influence of reagents. It is therefore evident that the changes are due to the living protoplasm.

The cell wall appears in all cases to have practically the same conductivity as the surrounding solution. If we subject living tissue to solutions of the same conductivity, but of different chemical composition, the resistance of the cell wall remains unaltered, while that of the protoplasm undergoes great variations. If, for example, living tissue is placed in a solution of CaCl or $CaCl_2$ (of the same conductivity as sea water) its behavior differs. In NaCl the resistance falls; in $CaCl_2$ it rapidly rises and later falls to a minimum. We infer that the permeability of the protoplasm increases in NaCl; and that in $CaCl_2$ there is a decrease followed by an increase.

The author then proceeds to analyze the factors involved in electrical resistance, and shows that the conductivity of the living protoplasm is less than that of the cell wall. An electrical current passing through a living plant flows partly through the cell wall and partly through the protoplasm. The relative amounts of these two portions of the current can be calculated.

Direct Prints Without a Camera

SOME years ago one Max Ullman patented a process for reproducing manuscripts, plates, drawings, etc., without the use of the camera. French investigators

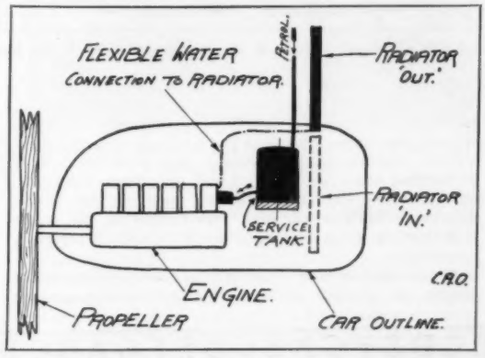


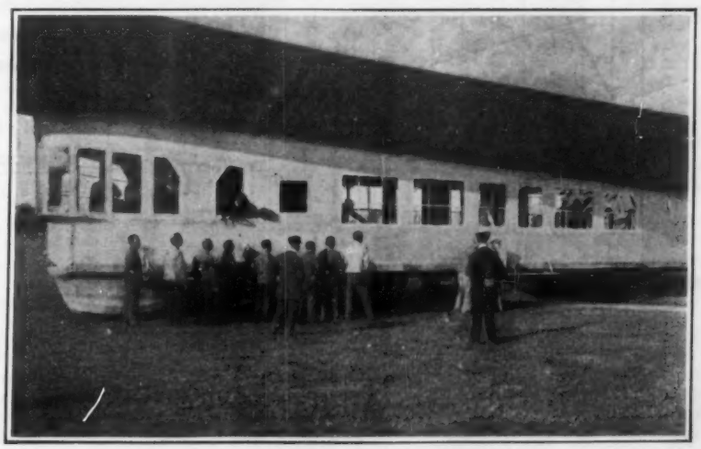
Fig. 8.—Diagram of an engine car, showing service tank and lead from storage tanks in the keel

are now giving considerable prominence to this, in connection with the claim that it was anticipated by Yvon in 1890 and more recently improved upon by Fontenay. *Le Procede*, *Photographische Korrespondenz*, and other foreign photographic journals are greatly interested not merely in the controversy but in the processes themselves. The French workers used gelato-bromide emulsions, while Ullman uses an egg albumin-bichromate film. The sensitive plate is placed in a frame provided with a glass front, the uncoated side of the plate being turned toward this glass. The document to be copied is placed with the text in contact with the sensitive surface, the frame closed and exposed to the light. Under these conditions the light which passes into the system is absorbed by the lines of the design, while it is reflected by the unprinted portions of the document; broadly speaking, it may be said that the amount of light acting on the sensitive surface where the high lights are is double that which acts in the shadows. If, therefore, sufficient exposure is given, the high lights of the original will be, in the coating, completely insoluble, while the design will represent a somewhat soluble area. By development, a relief is produced from which copies can be obtained. The original patent does not give satisfactory details, but Aug. Albert, professor at the Institute of Graphic Arts at Vienna, communicates some experiments on the procedure and claims to have obtained satisfactory results. The thick layer that results when ordinary gelatin bichromate mixtures are used is not applicable in the process, a very thin sensitive layer being necessary. Albert gives two formulas stating that both give good results. The one comprises white-of-egg solution in water, 25 cc.; clarified liquid glue, 20 cc.; potassium bichromate, 20 per cent solution, 20 cc. The white of egg should be beaten in a form and then filtered; and the entire mixture must be thoroughly mixed. The second formula involves water, 60 cc.; liquid glue, 30 cc.; ammonium bichromate, 10 per cent solution, 24 cc.; pure sugar, 12.5 per cent solution, 20 cc. Mix thoroughly and add a few drops of glycerine.

The materials used are not as clearly defined as they should be, but it is evident that the basis of one mixture is an albumin solution reinforced by gelatin, and that the commercial egg albumin and a high-grade gelatin can be used. In such case, a 14 per cent solution should be used. The albumin should be in fine powder and dissolved in cold water. The other mixture relies practically on gelatin and sugar, thus being substantially the gum bichromate method. The main point in the process is to secure a thin and very transparent film.

The duration of exposure is a serious difficulty, and it is recommended to use a very strong light of constant power. It is likely that a number of trials will be required before any exactness can be obtained. The development should be in cold or at most very slightly warmed water. After this is completed, the plate is immersed in a solution of fuchsin or some similar color, then into a yellow color (chrysoidin is recommended), in order to get a strong and non-actinic tint. After a short rinsing the negative is used in the usual way for copying on metal.

In this connection attention may be called to a process described and illustrated by Dr. Henry Leffmann in the *Journal of the Franklin Institute* for 1914, p. 178. This consisted simply in placing the sheet to be copied upon a glass plate that had been coated with luminous paint the latter having been strongly activated by exposure to light. Upon the original sheet a sensitive plate, film or development paper was placed and the luminous surface allowed to act for about ten minutes. Of course, the arrangement must be made in the dark and care taken that the sensitive surface is not exposed to the luminous one except through the subject to be copied. For copying short letters or diagrams written only on one side of the paper the process is satisfactory. It will not answer for copying from papers containing matter on both sides, as there will be confusion.



Passenger rigid safely landed. Note the air cushion below front end of car

Value of Casein Glue

CASEIN glues which have been widely used in aircraft work are as a class more water-resistant than animal and vegetables glues, but they are not, strictly speaking, waterproof. There is no glue that is waterproof in the sense that it is absolutely unaffected by water after a long immersion. Nevertheless, there are casein glues that are so water-resistant that plywood glued with them will withstand soaking for many weeks in water or exposure for many months to a warm damp atmosphere. Under similar conditions, animal and vegetable glues would lose their strength in a short time. For this reason casein glue is especially valuable in automobile body construction.

Wild Birds and Their Music

The Feathered Tribes of the Eastern States Identified by Their Songs

MOST of us have had the experience of hearing a burst of melody from behind some leafy screen, that urged us to exclaim, "I wonder what bird that is!" We have wished that some bird-man might have been at hand to identify the invisible singer by his song. "Be your own bird-man" is the key-note of a fascinating field guide by F. Schuyler Mathews, from which, by courtesy of G. P. Putnam's Sons, the accompanying illustrations are abstracted.

That portion of our country east of the Rocky Mountains is rich in bird life; among the many families that make this their home, some are distinguished by their resplendent costuming, some by their vocal performances, and others by their sheer buffoonery. If we are looking for that quality the dramatist calls "character," we may find it in full measure among the feathered tribes of our fields, coppices and forests. There are fops and exquisites such as the blue jay and the cardinal, operatic stars like the Baltimore oriole and the hermit thrush, and low comedians and "heavies" like the owl and the whippoorwill. Most of these performers have a *musical autograph*, and this makes their identification easy, even when we cannot see them. What we mean by "musical autograph" is very plain in the case of the bob-white and the whippoorwill, who enunciate their names with a clearness that carries conviction; but other birds, while they sing their names, do not sing the names we know them by. The American goldfinch furnishes a good example; his call note is often mistaken for that of his near relative, the canary; then he bubbles out into six or more rising chirps and three or more falling ones; but, like a wise author, he always follows these productions with the unmistakable signature "*Per-chic-o-ree*" to the notes G-A-F-E at the top of the treble clef.

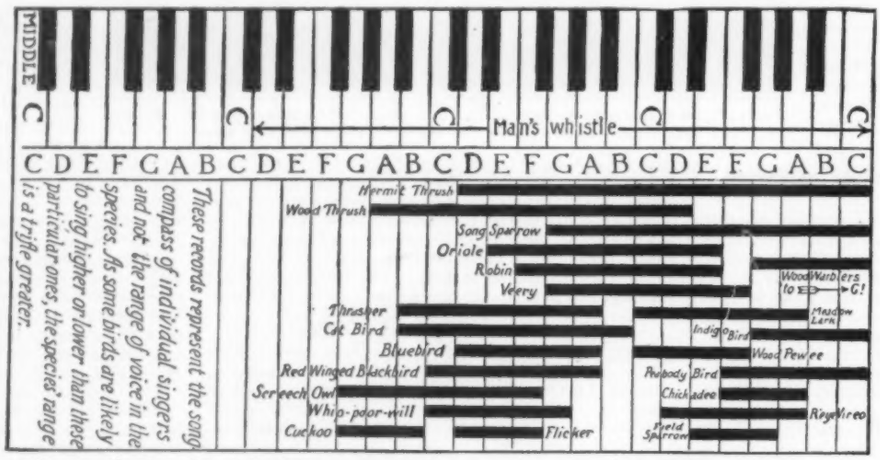

MIDDLE C
C
C
C
Man's whistle
C
C
C D E F G A B C D E F G A B C D E F G A B C D E F G A B C D E F G A B C
These records represent the song compass of individual singers and not the range of voice in the species. As some birds are likely to sing higher or lower than these particular ones, the species' range is a trifle greater.
Hermit Thrush
Wood Thrush
Song Sparrow
Oriole
Robin
Veery
Wood Warblers to G!
Thrasher
Cat Bird
Meadow Lark
Indigo Bird
Bluebird
Wood Pewee
Red Winged Blackbird
Peabody Bird
Screech Owl
Chickadee
Whip-poor-will
Red Eyed Vireo
Cuckoo
Flicker
Field Sparrow

Diagram showing the pitch of twenty-one bird songs compared with the keyboard of a piano

Some ornithologists hold that the use of the musical staff to convey the distinctive notes of a bird is of little value; they will find it hard to sustain their position in the face of the evidence presented by the author. Granted that many of these fantasias elude musical laws, they can yet be approximately and logically placed on the staff. Certainly this is the only means of locating a tone; syllables cannot locate tone, and are at best an uncertain guide to *quality* of tone; and while they are of some use in expressing rhythm or time, they often fail even in this. The white-throated sparrow is said to sing "*Old Sam Peabody, Peabody, Peabody*"—but who is to tell from this that the first of the three syllables of *Peabody* is sung to three beats, the second to one beat, and the third to two? The musical staff provides the only scientific way of conveying this fact.

The first diagram which we reproduce places the keyboard range of 21 birds; the second diagram records the range of 15 more. Most birds sing in strictly measured time, many give a perfect bar, and not a few give several bars. Incomplete as the song may be, there can be no doubt as to the accuracy of the time. Here we have a strong argument for the usefulness of the musical staff in the identification of songsters.

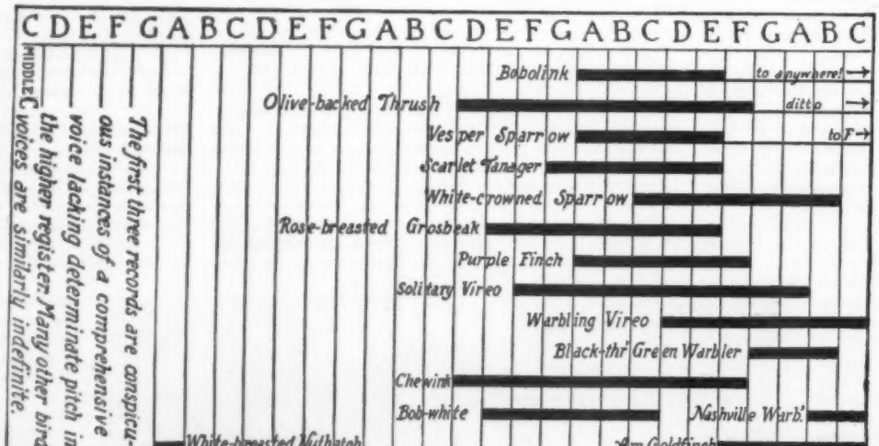

C D E F G A B C D E F G A B C D E F G A B C D E F G A B C D E F G A B C
MIDDLE C
The first three records are conspicuous instances of a comprehensive voice lacking determinate pitch in the higher register. Many other bird voices are similarly indefinite.
Bobolink
to anywhere!
Olive-backed Thrush
ditto
Vesper Sparrow
to F
Scarlet Tanager
White-crowned Sparrow
Rose-breasted Grosbeak
Purple Finch
Solitary Vireo
Warbling Vireo
Black-thr' Green Warbler
Chewink
Bob-white
Nashville Warb'.
White-breasted Nuthatch
Am. Goldfinch

Diagram showing the pitch of fifteen bird songs relatively with the keyboard of a piano

The thrushes are our supreme vocalists, and Roosevelt was not the only trained observer to exalt the hermit thrush above the vaunted nightingale. The rating is to some extent a matter of mood and taste; despite its monkish livery, the hermit thrush climbs to the peak of pure happiness, while the nightingale revels in the passionate and tragic; it is perhaps inevitable that the New World should prefer the joyous in art, and the Old World the more somber interpretations. The hermit thrush has the distinction, above all other birds, of having developed the Scotch, or pentatonic scale; this is the musical mode instinctively adopted by primitive man, and it has been memorialized most effectively by Dvořák both in his humoresque and in the largo movement of his New World Symphony. The nightingale essays this scale, but lacks the mastery of the thrush. While some of the fuller notes of the hermit thrush may be heard distinctly at a distance of a quarter of a mile, the listener should approach within 70 feet of the bird if he would gage the extent of the melodic variety, or appreciate the marvellous *pianissimo* and *crescendo* effects and the mysterious, ventriloquistic overtones that hold the hearer in thrilled surprise. This thrush has been known to approximate Wagnerian themes, such as the Rhine daughter's motive, and one was caught in the exact reproduction of a phrase from Strauss's Symphonia Domestica.

The wood thrush is a brilliant executionist, his notes coming in clusters of three, his intervals composing a perfect minor third. The veery, another member of the family, has a beautiful glissando of overtones, but without melody or definite pitch. Among other noted families of singers we may not overlook the bobolink, exponent of comic opera, with his musical fireworks; the Baltimore oriole, a musician in the fullest sense of the word; the purple finch—which is crimson, not purple, and is incomparable as a true warbler; and the song sparrow, the most gifted and versatile of his family. Not a song in their repertoire but can be fairly well-indicated by musical notation, always keeping in mind the fact that birds very often sing off key.

There are birds, too, that can by no stretch of imagination be called musical, but who furnish the comic and bizarre effects of the operatic orchestra. In appearance the owl is a low comedian, who can only turn his eyes by turning his whole head; but the wail of the screech owl, shattering the silence of night, has been compared to "the screech of a pioneer's wife as she is scalped by a red-handed Indian." It is unforgettable. The great horned owl, in addition to his uncanny Whoo, has the trick of emitting a blood-curdling cry bursting upon a prolonged G above the staff and sliding down to an abrupt A. Among the mimics are enrolled the blue jay and the catbird, who imitate with equal facility the squeak of a cart wheel or the liquid note of the thrush. And what shall be said of the whippoorwill, that bearded bird of the night, whose raucous tones the superstitious have long accepted as an omen of death? Nothing can be said in his favor as a songster, yet his cry, unique in nature, conforms perfectly to pitch and rhythm, though no two individuals sing exactly alike.

Excellent plates, many of them in color, accompany the author's notes; of the hundred-odd birds described in detail, the songs or cries of most are transcribed on the musical staff. The work further extends its usefulness by the six maps relating to the migrations of birds. As a guide to identification it leaves nothing to be desired, and it offers a rare treat to students and lovers of our feathered friends who put the pulse of life into inanimate Nature and fill her breath with melody.

Proteins Differ in Their Nutritive Value as Food

RECENT investigations in the field of proteins and nutrition conducted by the Bureau of Chemistry, United States Department of Agriculture, have shown that different proteins vary widely in their nutritive value. A diet may furnish a sufficient amount of protein, fat carbohydrates, salts and vitamines and yet fail to promote growth or sustain well-being unless the quality of protein is nutritionally adequate. Certain of the amino acids, of which about 19 have been found in proteins, are absolutely essential for growth and maintenance, among which are lysine, cystine and tryptophane.

A protein, which is deficient in lysine or cystine, even though it contains all of the other amino acids, will fail from a nutritive standpoint. The deficiency, however, when properly understood, can be supplemented by the addition of other foods to the diet which contain an adequate amount of these essential amino acids.

Studies with navy, adsuki, and lima beans have shown that these foods are lacking in cystine, the amino acid containing sulfur, and that all of them are therefore deficient as sources of complete protein. The lima, adsuki and other of closely related beans were found by similar experiments to require cooking and addition of cystine before they were adequate for proper nutrition. In practical feeding the deficiency of cystine in cooked beans could be supplied to provide the normal needs of man or animals by including in the diet meat, eggs, milk and cheese, and other common articles of food.

There can be no doubt of the fact that we are learning more about foods every day, thus making for a better dietary at a minimum of cost, for our individual requirements.

The inventor with his aluminum film which serves as a non-inflammable film

Aluminum Films

By Our Berlin Correspondent

THE transparent cellulose film, which so far had monopolized the field, will in future have to count with a serious, and possibly superior, competitor, the opaque, reflecting metal film.

While nearly uninflammable films have already been devised, a film made from organic material, such as cellulose, cannot, by its very nature, be incombustible. This, however, is the case of the aluminum film invented by M. Werthen, of Berlin, which, in addition, solves a number of other problems the film industry so far had to contend with. In fact, aluminum films are much more durable than celluloid films: Whereas the latter after a few weeks' use will be worn out and each time before being lent out anew have to be checked carefully until repeated clipping of defective sections will reduce their length to, say, half the original figure, aluminum films have a life at least ten times longer and can therefore be kept in permanent use for a whole year. Moreover, they are 40 to 50 per cent cheaper than celluloid films, and, if used on both sides, their superiority from an economic point of view will even be greater. Using the film on both sides, by the way, affords the additional advantage of reducing by half the amount and weight of film material required for a given record. When the first half, during the performance, has been unwound, the rear side with the second half is unwound in an opposite direction, thus dispensing with the necessity of winding up again in a separate operation.

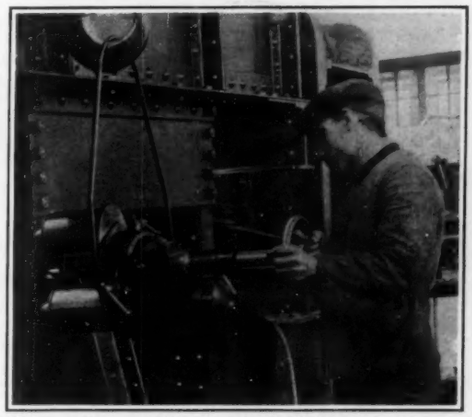
Another advantage is the better utilization of light. Whereas the never quite transparent celluloid film absorbs considerable amounts of light (15-18 per cent), the reflecting aluminum film enables the whole available luminous intensity to be utilized. To this should be added that the reflected picture never shows such abrupt transitions between light and shade as the projection of a transparent celluloid film, thus producing more pleasing effects on the eye. Reflection on the fine-grained aluminum surface, moreover, results in quite remarkable effects comparable with those of rotogravure, of which a surprising plasticity is the most marked.

The aluminum film is the outcome of twelve years' strenuous work, partly under difficult war-time conditions, unaided by the advice of others. Metallurgical, chemical, photographical and optical problems had to be solved, and experts in these various fields, whenever consulted by the inventor, would in good faith do their best to dissuade him from any further work on those lines. A special rolling process had, for instance, to be developed to obtain the uniform fine-grained metal surface of the aluminum film. A special photographic emulsion and, primarily, a special process for uniting the sensitive layer with the metal had to be devised, to which effect the inventor, imitating Nature's own practice of accumulating aluminum in the form of silicates, inserted between the metal and emulsion a silicon skin similar to water-glass. The combination thus obtained is so intimate that no mechanical treatment will sever the picture from the underlying metal, the film being bent and crumpled without loosening even the slightest traces of the photographic layer. Finally, the optical system used in projecting the opaque film had to comply with special conditions. In this case, too, the inventor did everything himself. In addition to making his own apparatus at the lathe and anvil, he would even grind his own lenses. By the addition of a special illuminating apparatus, the same projector can be used in alternately working with celluloid and aluminum films. However, any ordinary projector can, after shifting the lamp case, as well be used in this connection without any further alteration or adaptation.

Aluminum films can, of course, only be used as positives, preferably in connection with practically uninflammable cellon films as negatives.

A Magnet as Back-Stop for a Portable Drill

GERMAN contractors are using a novel application of the electromagnet, which ought to appeal strongly to any workman who has been called upon to match his weight and strength with an electric drill in the effort to hold the latter in place while it drills a large hole. The difficulty of doing this is sufficient testimony that if the human drill press were to be replaced by a magnet for the service of holding the drill in place, an extremely powerful magnet would be required for the purpose; but the ability of large lifting magnets to carry very heavy loads ought to be sufficient indication that magnets large and powerful enough to hold the drill down to its work are obtained without unreasonable expense. In any event, they are doing it in Germany, as our photograph indicates.

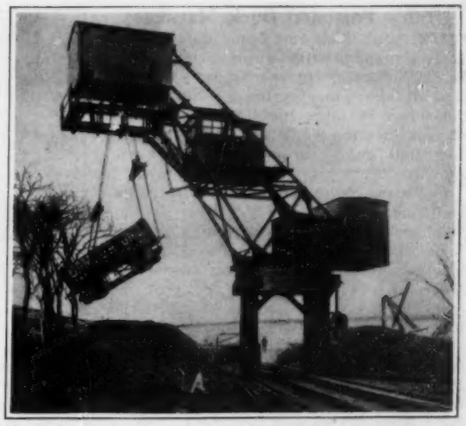


Holding the portable electric drill down to its work with a powerful magnet

Specifications for Fire Hose

CIRCULAR No. 114 of the Bureau of Standards is concerned with specifications for fire hose drawn up by the Bureau for use by government departments. The specification was submitted to the Rubber Association of America and has received the official endorsement of the technical committee on specifications. The hose purchased under the requirements of this specification is cotton lined and the types included are single-jacketed hose for use at fire hydrants, stand pipes, and similar places; double and triple-jacketed hose for use on pumping engines and in places where additional wear requires the increased protection afforded by the extra cotton jacket. The chemical and physical tests to which the hose must conform are described in detail.

A spark arrester that suggests a candle-snuffer



British apparatus that automatically records the weight of coal dumped from the cars

Car Dumper That Weighs as It Works

AMERICAN observers are accustomed to seeing large cargoes handled in bulk, and cars full of coal picked up and swung bodily through the air to be unloaded just as one unloads a spoonful of sugar. Britain is not so inured to sights of this sort, but it is nevertheless a British invention which we illustrate herewith. The feature of interest in connection with this giant crane, however, is not so much the free-and-easy manner in which it handles the coal cars, as the fact that it automatically weighs the coal as it dumps it. The full car is held suspended until the balance attached to the suspension comes to rest and indicates the gross weight; the same thing is done with the empty car after the contents have been spilled out; and the deduction is made automatically, registering the net weight of the coal dumped.

A Machine for Counting Bees

AN interesting problem was recently brought to the attention of the Bureau of Standards by the Bureau of Etomology of the Department of Agriculture. One of the members of that bureau has devised a gate to be placed at the entrance to a beehive and which permits only one bee to pass at a time. It was desired to obtain an arrangement which would automatically record the number of bees passing through this gate. It was found possible to arrange a series of telephone message registers in such a way as to accomplish this result. As in the actual work only alternating current was available for the source of power, experiments were made to find out the conditions under which these counters could be operated on rectifiers. The difficulty of using a battery for the purpose arose from the fact that 300,000 exits of bees per day from the hive are expected to take place. The amount of energy required at each exit is small, but on account of the number of bees which are expected to pass through the gate, the total energy needed per day is considerable. An emergency device has also been designed so that the apparatus will continue to operate from an auxiliary source of power in case of failure of the main power circuit.

The Spark Arrester Proves Its Worth

IN fighting the menace to forests from flying sparks it has been found through repeated experiments that a special form of spark arrester in position at the top of smoke-stacks is of positive value. The United States Forest Service has cooperated in these experiments, for the department has realized the vast economic waste that is brought about every year during seasons of prolonged drought.

Not only to forests is fire protection thus afforded, but also to various crops. For instance, previous to the installation of spark arresters on locomotives running through the South Park, or what is known as the "Hay Country" in Colorado, it was necessary to plow fire guards the entire length of the road. After the installation of spark arresters, the plowing of fire guards was entirely discontinued. Furthermore, since that time the railroad has not had a fire in the "Hay Country," nor paid any claims due to locomotive sparks in that district.

The making of this type of spark arrester is a very simple matter. The netting itself requires renewal about every thirty days. With this appliance the enginemen find they can leave their windows open without being bothered with sparks.

Utah's Poisoned Duck Marshes

THE Utah Fish and Game Commission is struggling with a very pretty problem in biological engineering, and its success or failure in effecting a solution will determine in large measure the amount of duck-shooting which the coming generation will enjoy throughout the United States.

For many years the pools and marshes and inlets of the Great Salt Lake in the neighborhood of what is known as the Bear River marshes have been extensive breeding grounds and resting places for ducks. In the spring there are considerable sections of this marsh land carrying as many as 300 nests per acre, and altogether many thousands of pairs bring the younger generation into existence on these marshes. In the fall the marshes serve again as a stopping point in the southward migration. This has been going on for nobody knows how long.

Dead ducks on the alkaline flats of the Bear River marshes, Salt Lake

In 1909 it was first noticed that many of the birds using the Bear River marshes came down with a curious sickness, and that in a good many cases this was fatal. No serious attention was paid the matter that year, but the next year, and every year since, the fact has been obvious that the ducks were on the road to extermination. It is conservatively estimated that as many as two million ducks per year die of this malady.

Investigation has established that the cause is a too great salinity of the water. Birds removed from the point at which they are stricken and placed further up the tributary streams, where the water is fresh, effect a speedy recovery in 90 per cent of the cases, even though many of them seem beyond aid. The onset of the malady is extremely rapid; within a few moments of settling down in the super-salty waters the ducks are too feeble to make their escape.

It is becoming increasingly plain to those interested in migratory birds that it is not possible to destroy the birds in any one section of the continent through which they pass, without seriously interfering with the supply in every other locality. The local aspect of the Utah situation is bad enough, for few gunners can enjoy a day's sport when the marshes are carpeted with sick and dying birds; but the Utah Commissioner regards the problem through national eyes as one menacing the country's game rather than merely one threatening the sport of a local constituency. Accordingly, he is making every effort to meet the situation.

Just how to meet it is the great problem. To date little has been done save to move sick birds back to fresh water. It is, of course, understood that this is no permanent remedy, but knowledge on which to base a better remedy is lacking. It is absurd to hope to educate the birds to discriminate between the salt content that is beneficial and that which is fatal, and it is equally out of the question to hope to frighten them from the deadly marshes. The logical attack lies rather through an answer to the question: "Why are these marshes fatal to ducks now, when for decades past they have not been so?"

The answer to this, in general terms, is easy. Due, doubtless, to some alteration of the drainage of the surrounding territory, for which the extensive irrigation works are no doubt responsible, the particular streams that drain into the marsh in question are today bringing down more salts than heretofore, or salts of different content from those of 20 years ago. The commission is doing its best to pass from generalities to specific facts, and to learn just where the deadly increment comes from. If it succeeds, new drainage or relocation of present drainage may be expected to carry this material to a point at which it can do no harm to the wild life of the lake.

In the meantime, the ducks are dying at the rate of over two millions per year; and we have an admirable illustration of the sort of environmental change, trivial from the physical or chemical standpoint, which may yet work toward extinction of a species. Apparently it is easier for nature to exterminate the ducks than for her to teach them the dividing line between salt water that is good for them and salt water that is bad. The record of the rocks is full of the remains of species that have perished through just this inability to make some relatively slight adjustment. In the present case, however, man is with the ducks in the effort to make adjustment unnecessary; and, just as he is apparently responsible for the present state of affairs, it may be hoped that he will find a solution that will enable the ducks to survive. But any solution, to be effective, must now be pretty prompt.

Men from the Utah Fish and Game Commission rescuing alkali-sick ducks and transporting them to fresher water

Room for Improvement

IF every car and truck designer would make it a point to see that each new model is capable of traveling under average conditions farther per gallon of fuel than the model immediately preceding it, the total saving in fuel during the life of the vehicles so improved would be astounding. Certain vehicles now extensively used in New York average nearly eight miles per gallon. A few years ago similar vehicles in the same service made about two miles. This shows what can be accomplished by intelligent development.

Preparing bees for winter, in hives that simulate the hollow tree as closely as possible

Science and Bee-Culture

SINCE the hollow tree with its straggling branches and devious openings in which the bee thrives best, is not accessible for bee-culture, a series of experiments conducted by bee experts of the United States Department of Agriculture have determined correct methods of construction and arrangement of the apiary. In other words, this improvised home, the handiwork of man, is camouflaged with realistic effects not unlike the domicile of the untamed bees of the forest.

The quarters of the nectar-sucking insect are designed for comfort and protection in winter as well as visualizing the hollow-tree idea. In determining a site for the apiary, select a grove of trees where the brisk winds of winter are virtually eliminated and the location partakes of the atmosphere of the untamed wilderness. An artificial windbreak, such as a high fence, is not nearly so efficient. It has been determined by an apiculturist of the Federal Government that a wind with a velocity of 20 miles an hour, spending its force on winter packing cases, will reduce the temperature of the packed hive even as low as that of an unpacked hive. Buildings as windbreaks are unreliable owing to the variable changes of the wind.

The bees should occupy the same place, winter and summer. The series of experiments of the Department of Agriculture indicate that shrubbery planted among the hives will serve as markers in directing their flights in winter and spring. True to the scientific deduction that bees are most happy and prosperous when subjected to environments approaching the forests, the shrubbery will not only serve as markers for their return from nectar-gathering errands in early spring, but assist in acclimating them to modern, man-made institutions.

Forest leaves, sawdust, planer shavings and broken cork are materials offering a diverse range of selection for packing of the hives in winter. The insulating value of this assortment of material is practically on a parity, despite exaggerated claims of some beekeepers in extolling the merits of broken cork or commercial insulating materials. The box containing the packing should be rainproof, permitting the insulation to be impregnable to rains and snows. For a climate comparable to Washington, D. C., it is advisable to provide four inches of packing underneath the hives, six inches on all sides, and eight or more inches on top. For climatic conditions similar to New York or Wisconsin, eight inches of packing on the sides and one foot on top is sufficient.

The scientific tests recommend unequivocally the use of bottom packing; otherwise, when hives are packed exclusively at the top and sides the heat escapes rapidly at the bottom. Heat vanishes from the hive not only by convection currents but by conduction and radiation as well. Consequently, when the bottoms are unprotected the insulating value in materials piled on the top and sides beyond two inches is practically nullified. To obtain a full measure of benefits from bottom packing it is essential to reduce the entrance to the hives, although it need not be closed.

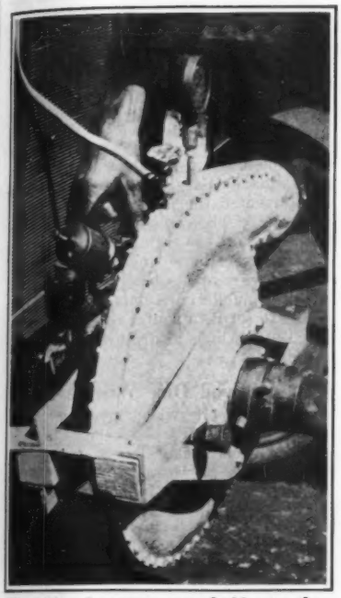
E. F. Phillips, apiculturist of the Department of Agriculture, has devised a special packing case which is being used in Government experiments. The four-colony type of case is sanctioned—two colonies face east and two west. All colonies are wintered in two full-depth hive bodies.

The sides of the case should be so built that the cleats which hold the boards together will support the overlapping sides on the bottom. A central cleat on the sides will prevent warping. The sides can be held in place and together by nails or hooks. The top of the case is made to telescope over the sides.

A tunnel, affording passage for the bees on warm days, will permit ventilation. Two boards, one the width of the packing (*e. g.*, six inches) and the other this width less the extension of the bottom board—is material for constructing the tunnel.

Inventions New and Interesting

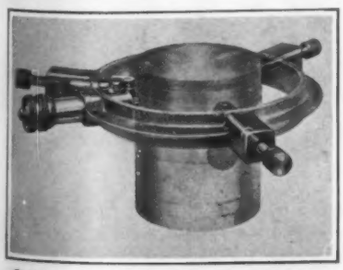
A Department Devoted to Pioneer Work in the Various Arts and to Patent News



Centrifugal pump, attachable to the fan pulley of a truck, for getting pressure in fighting rural fires

A Fire Pump for a Motor Truck

THE firemen of a small town often are confronted with lack of sufficient water pressure. To overcome this difficulty, J. O. Turner, of Franklin, Ky., has invented an auxiliary pump which can be quickly attached to any motor truck and which will increase the pressure to the desired degree. The pump works on the centrifugal principle and can be obtained in a single or double stage design. With a single stage, when the motor truck makes 1300 r.p.m. with a one-inch nozzle, where the city pressure is only 30 pounds, a pressure of 60 pounds is attained. The pump weighs only 50 pounds and is cast in aluminum. Four bolts enable one to attach it quickly to the truck. The only permanent change made in the engine mechanism is that the fan pulley of the truck must be replaced by a solid pulley to which the pump is attached. The suction hose can be dropped in a cistern or a well and a pressure of 30 pounds can be obtained under the same conditions as stated in the foregoing details. With a higher-power engine higher pressure is possible. Contractors having drainage problems during the construction of buildings can use the pump on any of their hauling trucks, and in a general way it is a valuable accessory for any truck owner.



Quick and handy tool for recutting or cleaning the grooves of pistons

A Combination Lock for the Gasoline Feed

THE latest attachment to render the parked car thief-proof consists in a little device that prevents anybody who has not an owner's knowledge from getting any gas to flow to the carburetor. A series of circular plates is mounted on the gas line, each plate having one or more holes provided in it. When the holes in all the plates are properly lined up, the gas flows; when they are not, it meets an obstruction in the unbroken face of one of the plates. The outer rims of the several plates carry the digits from 0 to 9, and the affair can be adjusted so that any desired six-figure number forms the combination. Once adjusted, the gas will only run when this setting of the discs is made; so that, in parking the car, the owner by disturbing the combination makes it impossible to drive the car away until he sets up the right combination again.

Track Laying Tractors in Alaska

CATERPILLAR-tread tractors have succeeded dogs as the motive power for hauling freight in many parts of Alaska, where these tractor and sledge trains are now operated regardless of the low temperatures. This is made possible by a recently perfected frost-pad which protects the cooling system in all temperatures. These machines have kept to their freight schedules at 40 below zero. An engineering asset of the most popular machine is found in the articulated roller-frame and the equalizer bar which join the two portions of the tractor truck and supporting roller. This latter factor enables the tractor to conform to the unevenness of the ground and to climb over obstacles and yet assures traction. It is one of the refinements and modifications made possible by war experience.

The notched plate by means of which the car is prevented from sliding backwards down grade

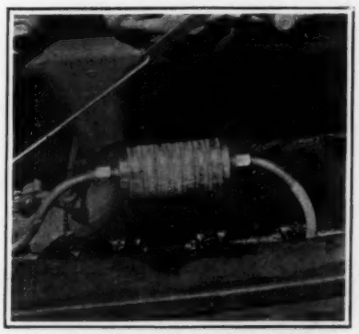
Simple Regrooving of Pistons

PISTON regrooving is reduced to its simplest terms by the device illustrated herewith. This tool is provided with correct-sized cutters and guides for all the more usual pistons, and these are instantly interchangeable. When it is necessary to deepen the groove, the cutter adjuster is provided with a micrometer of standard construction, and the depth may be accurately regulated by setting the tool one or two thousandths deeper for each cut. For ordinary cleaning of the grooves, the tool may be adjusted so that the cutter just sweeps the bottom of the groove, and a single revolution will clean it out thoroughly.

To Keep the Car from Sliding Downhill

THE accompanying photos show a device the primary purpose of which is to check the rearward movement of automobiles and automobile vehicles on any grade. This is accomplished automatically, quickly and noiselessly without assistance of any kind from the driver. The device employed is absolutely fool-proof; it works when it should and cannot be made to work when it should not.

By means of it an automobile can stop and start on any up-grade that the car

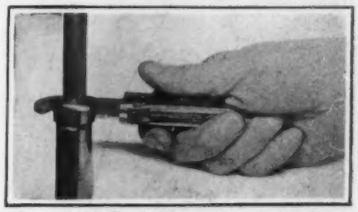


Only the owner who knows the combination can get gasoline to drive the car equipped with this device

can negotiate and on such grade can start as easily as on the level ground. Without it, in starting a load on a grade, the engine is often "killed" by reason of the excessive friction of the brakes which imposes upon the engine a load it is unable to start. Also very often the engine is "killed" when changing gears on a grade. The shaftlock in such cases instantly stops the rearward movement of the car. Again, oftentimes a parked car will start backward on a grade, even with the brakes applied, thereby causing accidents. With this device it is impossible for this to happen.

The device includes, first, a stationary plate attached to the transmission; second, a control plate that normally holds the four dogs in an inoperative position (so that the car can move forward or backward). This control plate is operated by the shift lever, and when moved slightly backward permits the four dogs to come in contact with four of the twelve notches in the third element—a revolving plate attached to the drive shaft. This checks the rearward movement of the vehicle on a grade when such rearward movement is not desired.

When in any of the forward gears the vehicle stops in its progress up grade, this device will automatically prevent it from backing down hill, or when shifted from any of the forward gears into "neutral," it will also automatically stop the car from going down hill backward. When shifted into "reverse" for the purpose of backing the car, the shaft lock will not interfere with the rearward movement; or when shifted from "reverse" into "neutral" the car will continue its backward movement without the shaftlock interfering in any manner. It will be realized that the device does not merely lock the shaft to the engine with its compression; it locks it to a rigidly motionless plate.



One "blade" of this pocket knife is a pipe-wrench

A Pipe-Wrench in a Pen-Knife

NUMEROUS handy tools of one sort or another have been combined with the pen-knife, taking the place of one or more of its multiple blades, and one might be pardoned for supposing that the limit of invention in this direction had long ago been reached. But we have never before seen the duplicate of the knife illustrated, which, in addition to the ordinary knife-blade, a can opener, a screw-driver and a punch, has a fifth blade in the form of a very handy pipe-wrench.

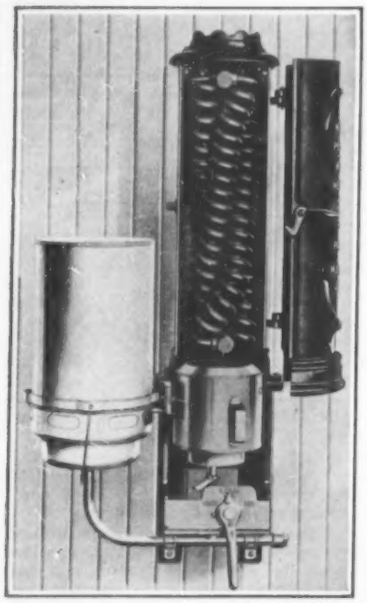
Stainless Steel for Engine Valves

STAINLESS steel is being extensively used for the inlet and exhaust valves of internal combustion engines of all kinds. It is also being used in at least one instance for piston rings, and for the bolts and nuts of exhaust pipes and mufflers. As usual, the best results are obtained by polishing the objects to a high degree. Such steels are cobalt-chrome alloys and are not so apt to change their character under extreme heat as other steels are.

Rustic Garbage and Trash Cans

A PARK that is frequented by picnickers finds that when plenty of receptacles are provided these people will be more careful to keep debris from the grounds and the tables. It did not wish to have the pretty park made less attractive by the view of numerous galvanized cans about, so a very effective plan was used to hide these refuse cans. An outer jacket was provided for each can. It is so finished that it resembles a

A garbage can in disguise



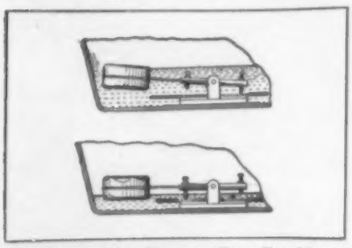
A kerosene water-heater of interesting design

stump of a tree in design and color, and is sanded to produce a rough surface. The trash can is set down into this "stump" and may easily be lifted out to be emptied. Nor need it be of so heavy material where it is protected by the jacket with the stump appearance. The park is thus rendered none the less beautiful by the can's added utility.

Four Cars in One

THE automobilist who is dissatisfied with the top that comes with his car has always had a wide range of substitute tops from which to select. Some of these have even been convertible, to the extent that one may make a more or less distinctly closed car out of what looks like an open one. Some of them deserve the war-time gibe contained in the tale of the man who was invalided home from France, and when asked how he got his wounds, explained that they were the result of his helping two of his buddies put up a one-man top on the company ambulance. And sometimes the added superstructure is more ambitious than the mere term "top" would indicate, and goes justly under the designation "body."

Seldom, however, does one encounter such a general utility affair in this line as the quadruplex body invented, and attached to his flivver, by J. J. McGuire of Yonkers, N. Y. Within a minute Mr. McGuire can convert his tin lizzie into limousine, touring car with victoria top, coupe, or runabout. The windows have been so constructed that they cannot be opened from the outside, and a tire compartment is provided beneath the rear seat. And when the car is in its touring dress, the front seat can be got sufficiently down out of the way to make good sleeping quarters immediately available for a party of at least two, as the inventor is demonstrating in one of our photographs.



The automatic oil controller that blows the horn when the oil is low and winks a light when it is replenished sufficiently. Note the two pins that make the "high" and the "low" contacts

Hot Water Anywhere

WITH this new water heater, suburban, country and farm houses can have a hot water supply if water is piped to the house. The heater burns kerosene at an estimated cost of one half cent an hour. The peculiar half turn of the coil is said to produce greater and more rapid heating capacity than the more usual designs.

An Audible "Low Oil" Warning

THE life and performance of a motor vehicle depend upon lubrication; the heart of an automobile is its engine and the blood of this heart is lubricating oil. We all know that; but the man who has been driving a car for any length of time without incurring a repair bill through neglect of this fundamental principle is a rare bird indeed. All manner of automatic warnings that oil is low or pressure failing have been devised, and we go right on driving our cars to destruction after we have been automatically warned.

James F. Chapple of Dallas, Tex., has got up a warning that is different. His device is a private chauffeur that never sleeps. He honks your horn when the car is nearly out of oil, and he will not cease making a noise until you pull a little chain and let the oil flow from the reserve supply tank into the crank-case. Then he becomes quiet; but when just the right amount of oil has been added to the crank-case supply he says "That's enough" by winking at you from the dashboard.

In less figurative language, Mr. Chapple's invention is an oil-lever indicating device that is much like the more familiar ones and yet muchly different from them.

It consists of two small sealed metal boxes which act as floats. They are attached to pivots placed in opposite ends on the inside of the bottom part of the crank case. There is a series of insulated wires strung between these pivots. Each float is attached to a short lever which in turn has affixed to it on each side of its fulcrum, short pins that can engage the wires referred to and complete electric circuits therein.

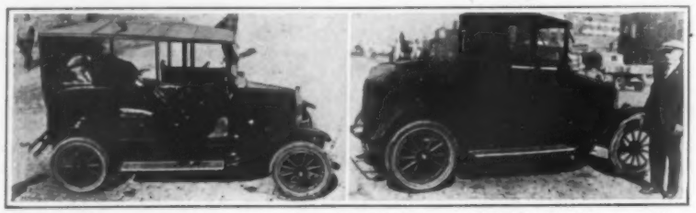
When the oil in the crank case is at the desired level the floats are raised and the forward pins drop in between two wires that lead to the dash light and the light is thus made to burn. This indicates plenty of oil. When the oil is nearly out, or dangerously low in the crank case, the two floats fall until their rear pins engage two other wires bearing an electric current that then goes to and sounds the horn, and be it known that this horn will bellow all day from that minute on until the car is given a drink of oil.

A reserve supply of oil is carried in a two-gallon specially built tank placed on the dash under the hood or on top of the crank case and from this reserve supply tank a piece of flexible tubing is run into the usual inlet for admitting oil to the inside of the crank case. There is a little spring valve at the outlet from this tank and from this valve a little chain runs through a hole in the dash and ends in a ring which is always within easy reach of the driver's hand.

When the horn begins to sound the driver has only to stick his finger into the ring and pull this little chain and the oil flows into his engine—the danger is over—the horn ceases to sound and the oil gurgles into a satisfied engine, which in appreciation, winks its eye—the dash light.

Fabric Shackle New Idea for Spring Support

IT is well known that the wear of spring shackle bolts is one of the main causes of cars becoming noisy in operation prematurely, and to eliminate this trouble, improvements in the lubrication of shackle bolts have been made by many designers in recent years. Another method of eliminating this trouble has been adopted recently by several designers which consists in completely eliminating the familiar spring shackle. The latest designs for pivotless shackles make use of fabric. It is claimed for this construction that it requires no lubrication and cannot rattle or squeak, that it will outwear the average spring shackle and that it also performs to a certain extent the functions of a shock-absorber. The tension type of shackle is made by clamping together four or more strips of rubberized fabric, which thus form a link or shackle which is bolted fast to the spring at one end and to the frame bracket at the other. The required clamping pressure is obtained when the shackle is assembled on the car, when the nuts which hold the shackle to the spring and to the bracket are tightened up. The clamping faces of the top and bottom boxes protrude at an angle in such a manner that under rebound the fabric strips act as cushion between them.



The touring car and the coupe are only half the possibilities of this versatile body for the flivver

Making Castings of Terra Cotta

THE casting of iron and other metals is an every day occurrence and familiar to most persons, but the pouring of terra cotta into the shape of castings is not so well known. R. F. Geller of the U. S. Bureau of Standards published a paper in a recent issue of the Journal of the American Ceramic Society on possibilities of terra cotta casting. The experimental methods described therein involved the treatment of clays and bodies with varying amounts of salts and cast in the form of small ashlars. The casting properties, viscosity, specific gravity and drying behavior of these kaolins, two ball clays, one fireclay and four representative commercial bodies, together with terra cotta clays, were studied. The author concluded that kaolins have an open structure, but do not develop strength on drying. Bonding properties are furnished by ball clays, which, however, tend to seal against the mold. Commercial terra cotta bodies tested do not possess good casting properties, but can be modified through a study of the component clays.

An individual rubber auxiliary for the public wash-bowl

Carry Your Own Wash-Bowl

WE do not mean to insinuate that all public washing places are unsanitary; many are kept up with the utmost care. But accidents will happen in spite of all precautions, and in many public places precautions are absent. The man who invented the portable rubber insert for the public wash-bowl which we illustrate did so after contracting an eye disease from using a public bowl. Now he carries his bowl with him, and uses the public bowl only as a place in which to set it, a source of water, and a place into which to drain it when he is through.

Wood Disc Wheels

AN automobile wheel in which a disk of laminated wood takes the place of the usual spokes has recently been developed. The wheels are made from the same grades of wood as used for airplane propellers and are laminated in such a way that the grain in each lamination runs in a different direction from the grain of the other lamination. The laminations are held together with special glue developed for the severe duties imposed on air propellers. These wheels are claimed to be of about the same weight as spoked wheels but to have four times the lateral strength. Tire inflation does not involve any unusual difficulties with this wheel, the pump tube being attached to the outside of the wheel. The wheel may be used with the same hubs as the ordinary spoked wheels.

A Pencil That Writes With Heat

THE latest application of electric heat is in the form of a simple pencil with a very hot point. This device, known as the electric pencil, can be used for a number of different tasks, and it is likely that many more tasks will be found for it in due course.

The electric pencil receives its current from the usual electric light socket. It consumes about the same amount of current as the usual electric iron. It is held

The electric scorching pencil

in the hand and used with almost the same easy swing as the usual pencil, while a shield protects the user's fingers from sliding down to the hot point.

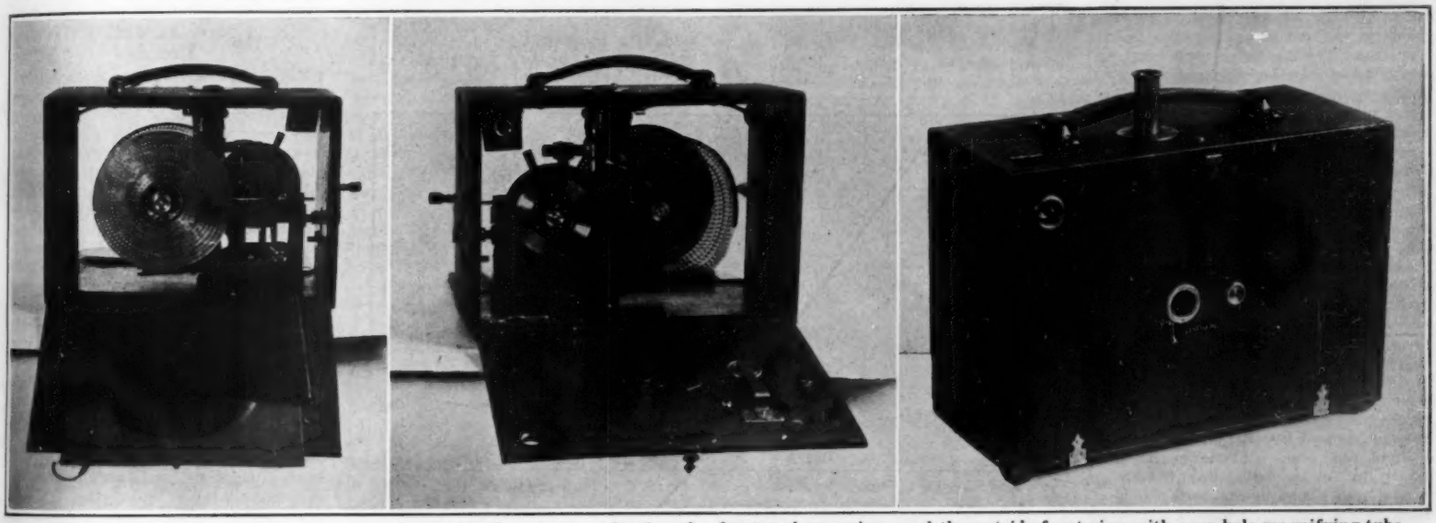
The heat of the electric pencil is sufficient to burn lettering and marks of all kinds on steel and other metal objects. In this connection it is invaluable as a means of marking tools so that they can be readily identified, in case they are lost or stolen. The electric pencil can be used in making out checks, for its scorched writing cannot be removed or altered. Beautiful decorative work may be done on wood and leather by means of the electric pencil, and it is even possible to write on glass. Bakelite, hard rubber, and other similar materials may also serve as the "paper," so to speak, for the electric pencil.

The Simplified Motion Picture

THE latest addition to an already large collection of amateur motion-picture equipment is the combined camera and projector shown in the accompanying illustrations. This machine, invented by O. Antonelli of Brooklyn, N. Y., makes use of a disk on which the images are arranged in a spiral, instead of the usual single-strip film ribbon

While the spiral image-arrangement is not altogether new, Mr. Antonelli has incorporated several novelties of his own in this combination camera-projector. First of all, he places the disk in a light-proof paper envelope, which can be loaded into the camera in broad daylight. Pulling a ribbon opens a small aperture in the envelope so that the sensitized surface can be exposed for the space of one image at a time. When the disk has been completely exposed, a second ribbon is pulled while the envelope is still in the camera, closing the aperture.

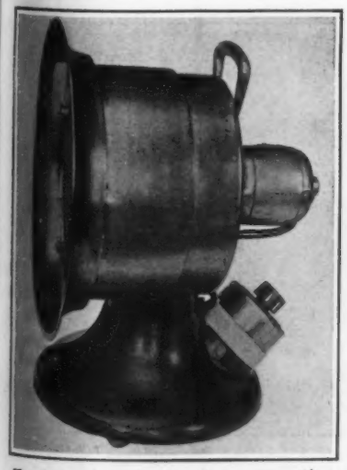
As a camera, this machine does very well indeed. The lens is of the focusing kind, and a peep-hole is provided for fine focusing and composition. Two shutters are provided, one for the camera work and the other for projection. The projector shutter has one large blade and two small blades to reduce the flicker, while the camera shutter has a single opening. The change from camera work to projector is readily made, and the machine, in its compact case, which is not much larger than the snapshot box camera, contains the lamp and other projection members.



Three views of a combination camera and projector for the amateur, showing the front and rear views and the outside front view with peep-hole magnifying tube raised for focusing

Warm Air Where It Is Needed

AMONG the recent electrical appliances is a combined blower and electric heater which serves to supply anything from cold air to warm air, where it is most needed. The device, which is shown in the accompanying illustration, is of exceedingly rugged construction, yet, thanks to its self-contained form and a convenient handle, may be readily carried about and used for many different tasks. For heating, it has distinct advantages over the usual electric heater, for it is warm air in circulation that gives the best results. For drying anything, this device is highly efficient.



Heating and ventilating in one operation

De-Inking Print Paper by a New Process

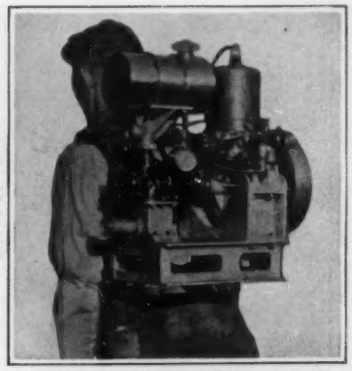
A NEW process for de-inking paper has already been patented by New York and New Jersey patentees. It is especially designed to remove ink from waste newspaper and the like. The old paper is macerated in an ordinary beater or is shredded in some other way. The resulting stock is then transferred to a beating engine. After heating to about 140 deg. Fahr. and making up to a consistency of about 6 per cent, enough soda ash or other alkali is added to give the whole a decided alkalinity. After beating for a short time, 10 minutes to half an hour, sufficient ordinary laundry soap is added to form a saturated solution and the heating is continued until the oil of the ink is thoroughly emulsified.

At this stage sufficient cold water is added to bring the consistency down to about 3 per cent and to reduce the temperature to 100 degrees. The effect of adding the cold water is not only to thin down the stock but also to throw more or less of the soap out of solution, with the result that as the agitation or beating continues, the emulsified soap, oil and pigment will rise to the top in the form of dark soapy bubbles. These may be removed from the surface of the stock as it flows around the beater by any convenient means, as for example by rotary washing screens but preferably by a rotary skimming mechanism devised by the patentees.

This mechanism consists of a wooden roller so arranged that its under side just touches or is but slightly above the surface of the stock. In front of the skimming roller are two inclined deflectors, extending under the roller for the purpose of concentrating the bubbles toward the center of the roller. Beyond the roller is a dam extending transversely across the channel between the midfeather and the side wall, and preferably inclined, with its upper edge close to the roller. The dam extends down a short distance into the stock, so that its effect will be to cause the stock itself to flow down and under the dam, while the bubbles, trapped by the dam, and brought into contact with the under side of the roller, may adhere to the latter and be carried upward.

Across the roller at a suitable point below the top is a doctor in close contact with the roller, so that the bubbles are scraped off by the doctor as the roller revolves. The doctor is inclined, and at its lower edge is a backstrip forming a trough. The trough thus provided is slightly inclined so that the oil, pigment and other matters will tend to flow down the same and out over the side of the wall, where they can be discharged. To facilitate this flow of the material, a spray pipe is provided, extending across the doctor at a slight distance from the same and connected at one end with a source of water under pressure. The pipe has a series of perforations on its under side, so that the water is discharged in the form of jets upon the doctor to wash down the material scraped from the skimming roller.

After the stock has been cleansed by skimming and washing as described, it may be formed into standard pulp laps on an ordinary "wet machine," or it may have added to it in the beater such color and mordant as may be desirable, and may then be run directly to the paper machine. For some purposes the cleaned stock may be mixed with new pulp in any desired proportion.



One-man fire-fighting outfit ready for action

The One-Man Forest-Fire Pump

FOREST-FIRE fighting is a serious business, these days, and calls for seriously thought-out equipment. The one-man pumping outfit which we illustrate is ample evidence that we have got away from the days when a shovel and a wet blanket comprised the standard apparatus for undoing the work of the spark-belching locomotive and the careless smoker. The pump is constructed throughout of hard bronze, with nickel-chrome steel shafts bushed with bronze wherever they come in contact with the water. Its guaranteed capacity is 20 gallons of water per minute under 85 pounds pressure. The engine is a single-cylinder two-cycle affair of 2½ horsepower, water-cooled by a stream bypassed from the pump. Ignition is, of course, by magneto. The gas tank holds four quarts. The weight is such that any ordinarily healthy man can carry it in the fashion indicated in our photograph, and operate it to good effect. The ability to direct a real stream of water under adequate pressure at a ground fire makes a huge difference in the tactics employed in subduing these conflagrations.

More Telephone Connections for the Radio Set

JUST so long as radio remained in the monotonous dot-and-dash state, a single pair of receivers was sufficient for the average amateur station. No one but the radio amateur was interested in "listening in," and there was no need for several pairs of receivers or a loud-speaking device.

The introduction of radio-phone pro-

The twin plug, making it possible to use two connections where ordinarily only one could be accommodated

grams sent out every evening by broadcasting stations scattered up and down this large country of ours, has made radio a very popular pastime. Now every member of the family wants to "listen in," and it is no longer a question of using a single pair of receivers, but one of providing a loud-speaking device or many pairs of receivers so that every member of the family and the guests as well can enjoy the radio-phone programs. The matter of connecting up a number of pairs of receivers, as well as the loud-speaking device, therefore comes up for discussion. What with the limited electrical knowledge of the average radio novice, it becomes necessary to use some simple method of connecting any number of receivers or loud-speaking devices into circuit with the receiving set.

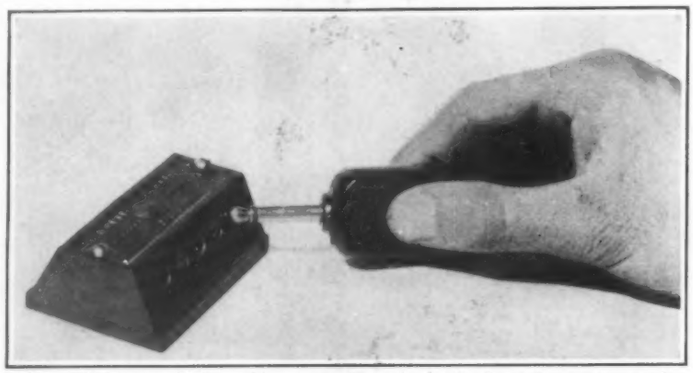
It has remained for Mr. Louis G. Pacent, a well-known radio man, to develop a method of connecting and disconnecting receivers and loud-speakers in and out of a receiving circuit. Aside from developing a plug especially designed for radio, which grips the tips of the telephone cords with a bull-dog hold that only becomes firmer as the connections are stressed, Mr. Pacent has now introduced a multi-jack device and a twin plug, both of which are illustrated in the accompanying views.

The multi-jack device is a block of composition material which is connected with the output terminals of the usual receiving set or amplifier, and which carries three jacks arranged in series. Any pair of telephone receivers or a loud-speaking device, provided with the usual plug, can be connected in circuit by pushing the plug into one of the jacks. The jacks are designed to short circuit automatically when not engaged with a plug, so that one, two or three plugs may be used at will. For a greater number of plugs, a second and third multi-jack unit may be added.

The twin plug is simply a larger model of the Pacent plug, containing two jacks. In this manner two plugs may be used where one would ordinarily be accommodated.

An Electric Iron for the Odd Corners

THE usual electric iron is at times not quite so practical as it might be, for the reason that ironing must be done in odd corners of dresses or millinery, and the large and heavy iron cannot be worked in such narrow confines. There has just come to the rescue of the ironer a new device which resembles nothing so much as a deformed golf stick; that is to say, it has a metal head and metal stem, with an insulated handle. The device may be used to iron ribbons, hat trimmings, fine laces, ruffles and so on, either by running it over the work or having this little iron mounted rigidly on the table and running the work over it. Our illustration shows the iron used both ways.



The multi-jack, which enables several receivers, loud-speakers, etc., to be plugged in at once

For ironing in armholes, pleat-ends and other tight places

What Color Is the Paint?

THE buying of paint is often a matter of uncertainty. There are so many shades and finishes that as likely as not the wrong paint may be purchased, with consequent disappointment.

A Western paint manufacturer, fully cognizant of this state of affairs, has introduced a simple method of taking the guess-work out of paint buying. As the paint is being packed into cans in his factory, a daub of paint is put on the side of each can and allowed to dry. The label, which is placed around the can, has a small hole cut in it so as to let the daub of paint show through. The proper wording on the label calls attention to the fact that a sample of the finished paint is framed by the little circle. In this simple manner the guess-work is taken out of paint buying, and there is no real reason for subsequent disappointment.

Mud Shoes for the Horse

HORSES employed in drainage, in the farming of very soft land, etc., have to be specially shod to prevent them from sinking into the muck in which they have to get footing. We illustrate herewith one of the forms in which this necessity has been met—a large auxiliary shoe clamped temporarily to the hoof over the regular shoe.

A Novel Suggestion in the Two-Cycle-Engine Field

THE automotive industry always has numerous untried suggestions or partly-tried designs which are of interest on their own grounds, regardless of their ultimate success. One of these which comes to our attention is a two-cycle engine which does work on only one side of the piston. This apparently anomalous result is accomplished by the aid of a secondary piston, with a connecting rod of its own that passes through the main piston and is driven by cam, so that its motion may be straight up and down. When the main piston goes up the other goes down, and vice versa. The two are together at points near top and bottom dead centers; and their respective strokes are so arranged, with reference to intake and exhaust valves distributed at various parts of the cylinder, that the subsidiary cylinder attends to the business of intake, while exhaust is partly secured by the extreme end of the main stroke, plus the action of the secondary piston. This leaves the main piston free to give the bulk of its travel to compression and power strokes, and to have one of the latter on every downward journey through the cylinder. Among the details worthy of mention is the claim that extraordinarily advantageous fuel mixture is gained by the by-passing of the fuel from the space between the pistons through vents in the auxiliary one, into the combustion chamber. Doubtless this expectation of better mixing is the basis for claiming superiority to the ordinary two-cycle engine; and the more frequent power stroke is relied upon to give a favorable comparison with the four-cycle engine of like number of cylinders. While some of the claims seem a trifle rash, the idea is on the whole of interest.

To keep the horse from sinking into soft ground

Striking New Automatic Welding Process

INFORMATION comes from England of a new system of automatic welding which seems likely to produce far-reaching effects and to be widely used in the future. It has been devised by I. J. Steele, chief electrician of a British shipyard. It is claimed that a solution has been found to the problem of welding together dissimilar metals of widely different welding points, such as brass to steel, etc. The unique feature of the process consists in the claim that masses of metal, differing both in size and in quality, can be automatically welded in a single operation by pressing an ordinary bell-push.

Only the metal parts to be welded are heated, and no reinforcing with metal from any other source, such as a metallic electrode or the use of any flux, is necessary. It is the only process in existence which will weld metals of widely different character and section. A brass plate can be welded to armor plate. The new process was developed in the first instance to meet Admiralty requirements in naval construction, and especially in order to obviate the piercing of bulkheads—in fact, to eliminate all drilling—and thus maintain watertightness. The importance of that will be realized from the fact that on a ship of the "Queen Elizabeth" class there are 350,000 quarter-inch holes in the bulkheads for the attachment of studs, and each hole is a potential leak.

The daub of paint on the outside of the can matches the contents, and shows through the round hole in the label

The Service of the Chemist

A Department Devoted to Progress and Achievement in the Field of Applied Chemistry

Conducted by ISMAR GINSBERG, Chemical Engineer

Production of Gas by Electricity

TO convert coal and other combustible materials into gas, it is necessary to supply heat to the apparatus in which the gasification takes place. Generally a part of the combustible is consumed in the process for this purpose. Electricity has been used for heating, and in the German journal, *Zeitschrift fuer angewandte Chemie*, 1922, 73, there is discussed the application of electricity to the gas production process. Electricity can be used for the complete gasification process as well as in the process of destructive pyrogenous distillation. The advantages of electricity in this connection are the simplification of the industrial apparatus required for the gas-making process, the more economical utilization of heat, the easy attainment of any desirable concentration of heat without danger of consuming the combustible, and the more expeditious use of pressure and contact materials in the process.

The consumption of current in the complete degasification process depends but little on the quality of the combustible or on that of the gas. It amounts to about 1.1 to 1.3 kilowatts per cubic meter of the gas. The process becomes decidedly economical when it can be run so as to utilize the excess current produced by the power plant. The gas, produced in the electric process from solid fuels and possessing a calorific power of 2800 to 3000 heat units per cubic meter, is especially useful in high temperature production, in reduction processes and syntheses, as an addition to illuminating gas, as fuel for motors and gas turbines and as a raw material for the manufacture of liquid combustibles. The gas that is made from liquid fuel and possessing a calorific power of 5000 heat units per cubic meter, can be used directly as illuminating gas and for all industrial and domestic purposes. The electric process of manufacturing gas permits the utilization of low grade fuels for this purpose. The process may be carried out in apparatus much smaller than that used in the ordinary gas process.

Uses for Lime

THE most common use for lime, and to most people the only use that they know of, is in construction work, in the making of mortar and plaster. There are, however, many other uses for this commodity, as is pointed out in the article, published in *Chemical and Metallurgical Engineering*, 1922, 294-300. A very comprehensive diagrammatic table of the uses to which lime is put is given. There are many chemical uses, such as in the manufacture of medicine, the vulcanization of rubber and other processes of a catalytic nature, in the preparation and preservation of food, and the purification of materials, as in the gas industry. There are many different agricultural uses. The article is a real revelation of the numerous diversified fields in which lime is of technical importance.

New Wood Preservative

FROM German sources it is reported that the alkali salts of oxymercuric acetic acid and like preparations have been found to be very useful as a wood preservative. It is claimed that only 0.01 to 1 per cent of these salts need be used in a solution to obtain good results. The wood is impregnated with this solution and then exposed to the air. The carbon dioxide in the atmosphere decomposes the alkali salts and the active mercury derivative is precipitated on the fibers of the wood in an insoluble form. Acids may be used to hasten this action. In order to obtain an even stronger disinfectant action, the solution of these alkali salts is admixed with metallic salts, such as copper sulfate, lead acetate, tin chloride, etc.

Synthetic Edible Fats

WITHIN recent years much experimentation has been done, particularly in Germany, in the attempt to produce edible fats artificially. In the German journal *Chemiker Zeitung*, 1922, page 157, there is given a description of some preliminary experiments on this subject which were performed with isopropyl alcohol and stearic acid. The isopropyl ester of stearic acid is formed, which melts at 24 degrees Centigrade and possesses a mild taste and odor. It is claimed that this fat can be used as a food. On admixture with suet and milk, an oleomargarine is obtained which also has a mild taste and is altogether a recommendable product. The experimentation is being continued and further results will be published shortly.

Paper from Carmia Fiber

EXPERIMENTS have been conducted in Brazil to see whether paper could not be made from the fiber of the Carmia plant which grows very profusely in that country. The results have been very encouraging, and not only is a good paper made from this fiber, but it may also be used to good advantage in making rope and twine, and in the manufacture of artificial silk.

Petroleum, the Basis of Chemical Industry in Poland

ACCORDING to the German journal *Petroleum*, volume 17, page 332, a Polish chemical industry is being established, based on the pyrogenous distillation of Galician petroleum. Such a distillation is, of course, directly opposite to what is generally carried out in petroleum refining. The products of this distillation consist, in addition to illuminating gas, of 6 to 8 per cent of benzol, 3 to 4 per cent of toluol, 1 to 2 per cent of xylol, 3 per cent of naphthalene and 0.5 per cent of anthracene, besides 12 to 15 per cent of pitch and 10 per cent of different oils.

Canning Food with Inert Gas

THE point of prime importance in the canning of food is the effective preservation of the same so that when the food is ready to be eaten, it will not have undergone any decomposition or deterioration. The tin can is perfectly successful in keeping air away from the food, but there is always a certain amount of oxygen entrapped with the food within the can, and the change in flavor that canned goods suffer has been definitely assigned to this oxygen in the can. A new process for the removal of the same by its replacement with inert gases is described in the *Chemical Age* of February, 1922. Besides keeping the flavor of the product as it was in the original fresh state, this process of canning also adjusts the internal pressure in the can to atmospheric pressure, which relieves the seams of the can from strain and enables the packer to use lighter weight tinplate. It also avoids corrosion and pin-holing where due to oxygen. It is claimed, furthermore, that the inert gases improve the flavor of the canned food and preserve the vitamines.

Oil from Seeds of Rubber Plant

IN the fourth year of its life, the rubber tree produces seeds, and these are produced regularly after the eighth year. These seeds contain about 50 per cent each of kernel and shell. The air-dried kernels contain on the average about 45 per cent of a drying oil. This oil hardens in air and can be used in making linoleum and soft soap. For further details, the reader is referred to *Gummi Zeitung*, volume 35, page 500.

Mineral Oils Soluble in Water

GERMAN Patent No. 342,149 is concerned with a process of rendering mineral oils soluble in water by treatment with sulfur trioxide at high temperature without danger of carbonization.

Sponge Rubber as a Heat Insulator

FOR some time in the past, strenuous efforts have been made to find new uses for rubber. The National Physical Laboratory, which has been occupying itself with this problem, has announced that sponge rubber, which is a particularly porous form of rubber, made by conducting the vulcanization process under a pressure of 100 atmospheres, may be used with success in lining refrigerator walls. When the double walls of ice-boxes were filled with sponge rubber of the above nature, the heat transmission through the walls was found to be only half as great as when cork or other insulating materials were used.

Asphalt in Argentine Republic

LARGE deposits of asphalt have been found in the Argentine in close proximity to oil fields. The interesting feature about these asphaltic deposits is that they also contain considerable quantities of vanadium.

Tetralin in Soap Manufacture

TETRALIN is the product that is obtained when tar camphor, that is, naphthalene, is treated with hydrogen in the presence of a catalyst. When tetralin or tetrahydronaphthalene is subjected to the action of sulfuric acid and then to that of an alkali, the sodium salt of tetralin sulfonic acid is produced. The solution of this salt in water possesses soap-like properties. The use of this substance in admixture with soap is recommended, for it has the property of rendering the same soluble in hard water. The reader is referred for further details to the *Zeitschrift fuer angewandte Chemie*, 1922, page 27.

New Alcoholic Disinfectant

ISOPROPYL ALCOHOL is a comparatively new commercial product, which is assuming importance as a substitute for ethyl alcohol. Certain experiments have been conducted in the laboratories of the City Hospital in Friederichshavn, in Berlin, where it has been found that the new alcohol can be used to good advantage as a disinfectant of the hands in the place of ethyl alcohol. It has also been ascertained that the same effects can be obtained with a much smaller amount of the isopropyl alcohol. For further details the reader is referred to the *Vergl. D. med. Wochenschrift*, 1922, page 68.

Lead and Zinc Tailings as Fertilizer

EXPERIMENTS made at the University of Wisconsin have indicated that the tailings recovered from the lead and zinc mines of southwestern Wisconsin may be used to good advantage as a fertilizer. There does not appear to be any danger of poisoning due to the lead or zinc nor of the development of sulfuric acid by the oxidation of the sulfide. As much as four to five tons to the acre have been used without any injurious effects and with marked benefit to clover and alfalfa crops.

Radioactive Fertilizers

A COMPANY has been incorporated in Czecho-Slovakia, in which country there are large radium and uranium mines, controlled by the State, for the purpose of making fertilizers containing radioactive earths. Remarkable results are claimed from the use of such fertilizing materials.

Pasteurization of Milk

ONE of the principal difficulties that has to be overcome in the pasteurization of milk is to avoid changing the appearance, odor and taste of the milk during the process. If the temperature is not controlled carefully and the heat treatment allowed to continue beyond the proper length of time, then the various albuminous and fatty constituents of the milk are thrown out of colloidal suspension and the milk thickens and acquires a taste which stamps it at once as an improperly pasteurized product. To avoid this happening and also to correct milk which has been spoiled in this manner are the objects of German Patent No. 329,214. This process consists in passing indifferent gases, such as air or oxygen, through the milk, while it is being subjected simultaneously to a rapid sterilization or pasteurization. This is accomplished by alternate sudden internal heating and cooling, which brings about sudden changes in the temperature. To this end gases of a comparatively low temperature are made to pass through highly heated milk and highly heated gases through cold milk. The milk, for example, may be warmed to 40 to 50 degrees Centigrade, and gases, heated to 250 to 350 degrees Centigrade, are passed through it.

Sponge Asphalt

WHEN ordinary asphalt is melted and allowed to run out of an apparatus, provided with a spout, in such a way that the stream of molten material is made to come in contact with a stream of air, a product, full of air cells, is obtained after the mass has congealed, or, in other words, sponge asphalt is produced. This material possesses valuable properties, which render it usable as a packing between cement or paving blocks, for electrical insulating purposes, as a heat insulator in freight cars and refrigerators and as insulation against moisture and sound. The process is patented in the United States. (See U. S. Patent No. 1,401,974.)

The Heavens in July, 1922

The Photographic Search for Novae, and Some of the Conclusions Drawn from the Results

By Professor Henry Norris Russell, Ph.D.

WHEN astronomers travel together, like other human beings they sometimes "talk shop"—and again they don't. The writer has been in the same boat—literally—with the Director of the Harvard College Observatory for a fortnight; but there has been less discussion of the sidereal universe than might have been the case if there had not intervened such opportunities for observation of our own planet and its inhabitants as occur in the course of a Mediterranean cruise. Some bits of talk, however, may be worth passing on to the "gentle reader."

Mention has probably been made long ago in these columns of the important work of Professor Bailey and his associates at Harvard upon the frequency with which temporary stars, or novae, appear in different parts of the sky. It has long been known that such objects are almost, though not quite, completely confined to the Milky Way; but the question of their relative abundance in different parts of the Galaxy has been less thoroughly studied until recently.

Only the brighter novae, which rise above the fourth or third magnitude, are likely to be discovered with the naked eye; though the occasional objects which, like Nova Aquilae of 1918, rival Arcturus or even Sirius, have been detected independently by dozens of observers. For the fainter members of the class photographic methods are necessary—and here the great Harvard library of celestial photographs is of enormous value.

For some years past a careful and systematic study of the Harvard plates has been made with this end in view—comparing all the different photographs of the same region and looking keenly for newcomers. This search has been rewarded by the discovery of a considerable number of novae, too faint to have been seen with the naked eye, but plainly recorded on the plates, awaiting the searcher, though years may have passed since the photographs were developed and filed away.

The Extent of the Universe

Two important results have emerged from this investigation. In the first place, it is found that the brighter novae are distributed about at random in galactic longitude; in other words, they are about as likely to appear in one part of the Milky Way as in another. But for the fainter ones this is by no means true. By far the larger proportion of these have appeared in one half of the Milky Way, extending from Cygnus through Aquila and Sagittarius to Centaurus; while the other half, including Cassiopeia, Auriga and Orion, has shown very few. A conspicuous concentration occurs in Sagittarius, in the region of the great star-clouds.

This phenomenon, though very striking, is not hard to explain, at least tentatively. From various researches—notably those of Dr. Shapley—we have good reason to conclude that the "universe" of stars which surrounds us has its center far away from the sun—at a distance of 50,000 light-years or more, and in the direction of Sagittarius. In this direction the Milky Way extends, star-cloud behind star-cloud, to a depth of perhaps 200,000 light years, while on the opposite side of the heavens its depth is very much less. We may put this fact together with another—namely, that the best existing evidence indicates that the brighter novae have been in reality of gigantic luminosity—often more than 10,000 times as bright as the sun—and that even the nearest appear to have been at distances of many hundreds of light-years. If the fainter novae, which at maximum reached only the eighth or ninth magnitude, were of the same real brilliancy as the others, their distances must have been 50 times as great, or thereabouts, and in some cases have exceeded 50,000, or even 100,000, light-years. At the smaller distances of the brighter novae, there are probably about as many stars, roughly speaking, in one direction as in another; but at the vast distances of the fainter ones, the stars probably get very thin in the direction of Auriga or Orion, while they are presumably still abundant in that of Sagittarius. The lop-sided distribution of the fainter novae, favoring one-half of the Milky Way, is therefore quite in line with these modern views of their actual brightness and of the extent of the universe. When we know a little more, it may even help us to map out the depth of the Milky Way.

The second result of the Harvard investigation is even more remarkable. The number of new stars which have been detected on the plates is evidently only a fraction of those that actually appear in the heavens. Thorough as the "patrol of the sky" has been, it is not possible to cover every region of the sky by plates taken at intervals so short as to be sure of including the time during which a nova was near its maximum—for this is often but a few days. Moreover, there are months in every year when any given region of the sky is near the sun, and the stars in it cannot be observed or photographed at all. Taking all this into account, it becomes clear that only a small fraction of the novae which appear will actually be caught on the photographs. From such considerations Professor Bailey draws the conclusion that the number of novae brighter than the tenth magnitude which appear in the whole heavens may be estimated at about 15 every year. About one in a hundred of these becomes bright enough to become conspicuous to the naked eye—though not to be picked out from the multitude of stars by an untrained observer. Most of the fainter ones have been missed in the past, and probably a good many of the brighter ones, either because they were too far south or because they blazed up when they were in the part of the sky near the sun.

Novae and Ordinary Stars

An important inference may be drawn from this conclusion. If temporary stars are appearing at the rate of 1500 per century, the total number which have undergone maxima during geological time must be extremely great. Life has probably existed on the earth for a hundred million years, and during this time (if we may judge by the present) there should have appeared no less than fifteen billion outbursts of novae brighter than the tenth magnitude.

Now the total number of stars in the visible part of the universe is probably less than this—so it would appear that the average star has probably undergone at least one catastrophe of the nova type during geological time—if not more than one. Such an increase in the light and heat of the sun would unquestionably destroy all terrestrial life, and we may be sure that nothing of the sort has happened since pre-Cambrian times. Are we then to regard the sun, asks Professor Shapley, as an unusually stable star? This seems doubtful, since the sun presents every evidence of being a typical dwarf star, in a fairly advanced stage of evolution, corresponding to early middle age; and there are probably millions like it in space.

Perhaps the solution may be found in a fact noticed by various students, and pointed out recently by Lundmark. The new stars do not appear indiscriminately in the Milky Way, but are found on the edges of those dark areas and patches which are believed to represent clouds of opaque matter, obscuring the Galaxy behind them. This suggests Seeliger's hypothesis that the outbreak of a nova depends in some way upon a collision between a star and one of these clouds of dust or meteorites. If this is true, the stars which are situated in the neighborhood of these clouds, or which chance to move into it, will stand a much larger risk of becoming novae, while others will be unlikely to undergo such a catastrophe. The immunity of terrestrial life from destruction through so long a period may therefore perhaps be attributed to a fortunate position of the solar system in space, remote from the dangerous cosmic clouds.

At 11 o'clock: July 7.
At 10½ o'clock: July 14.
At 10 o'clock: July 22.
At 9½ o'clock: July 30.
At 9 o'clock: Aug. 7.
At 8½ o'clock: Aug. 14.
At 8 o'clock: Aug. 22.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on July 7, etc.

NIGHT SKY: JULY AND AUGUST

The Planets

Mercury is at his greatest elongation, 21 degrees west of the sun, on July 11th, and so is a morning star all through the month. He is in Taurus and Gemini, far north of the celestial equator, and is therefore well placed, rising at 3:40 A. M. on the 1st (standard time, as throughout), and 3:20 on the 15th. Toward the end of the month he draws in between us and the sun, and becomes hard to see. At his best he is brighter than Capella or Arcturus, and a conspicuous object.

Venus is an evening star in Leo, still increasing her apparent distance from the sun, though slowly, but at the same time moving southward so that the time of her setting grows earlier, changing from 9:35 P. M. on the 1st to 9:05 on the 31st.

Mars is in Scorpio and very conspicuous in the evening sky. He moves westward at first, then, on the 16th, reverses his motion and begins his long eastward course around the zodiac. All through the month he is near the bright star Antares—at first 5 degrees west of the latter, then approaching to within 3 degrees, then receding again. His distance from the earth increases from about 45 to 55 millions of miles, and his brightness fades accordingly; but he greatly exceeds Antares—about sixteen-fold at the month's beginning, and ninefold at its close.

Jupiter is in quadrature with the sun on the 2nd, and is therefore accounted an evening star. He is about 3 degrees south of the equator, and sets close to midnight on the 1st and at 10:05 P. M. on the 31st.

Saturn, like Jupiter, is an evening star in Virgo, but is a little lower in the sky and sets about 20 minutes earlier. Uranus is a morning star in Aquarius, and crosses the meridian at 3:23 A. M. on the 16th. Neptune is technically an evening star, but is too near the sun to be observable.

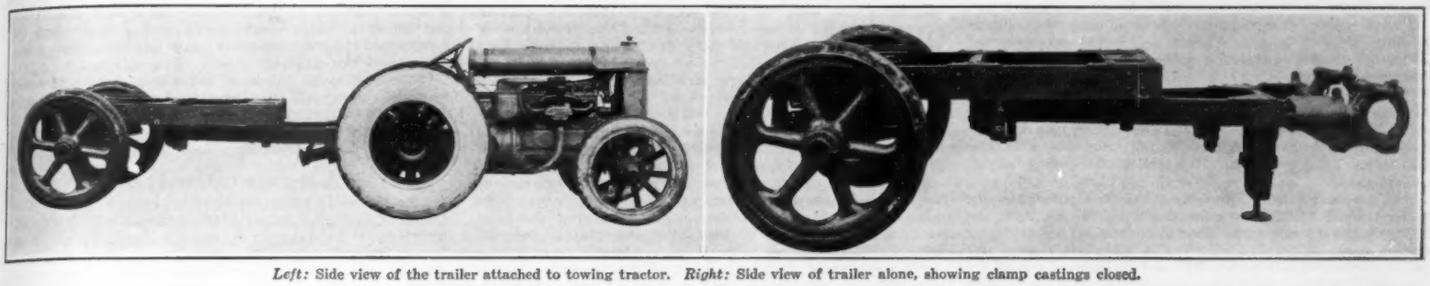
The moon is in her first quarter at 6 P. M. on the first, full at 10 P. M. on the 8th, in her last quarter at midnight on the 16th, new at 7 A. M. on the 24th, and again in her first quarter at 11 P. M. on the 30th. She is nearest the earth on the 26th and farthest away on the 14th. During the month she passes by Saturn and Jupiter on the 1st, Mars on the 6th—at the unusually great distance of 8 degrees—Uranus on the 13th, Mercury on the 22nd, Neptune on the 25th, Venus on the 27th, Saturn again on the 28th and Jupiter on the 29th.

On board S. S. "Patria," in the Ionian Sea, April 7, 1922.

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGE, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles



Left: Side view of the trailer attached to towing tractor. *Right:* Side view of trailer alone, showing clamp castings closed.

Two views of a new two-wheeled trailer for agricultural work

An Innovation in Trailers

A WHEELED trailer designed to connect directly to the tractor rear-axle housing through adapter castings which clamp solidly to grooves in the axle housing, immediately inside of the wheel, is now being marketed. The adapter casting is a cast-iron bushing designed so that the steel clamp that encircles same may swivel radially on the adapter casting on the axle housing, thus eliminating any wear on the axle housing, and throwing all the wear on the adapter casting, which may be quickly and cheaply replaced.

A special connection underneath the main frame of the trailer pivotally mounted on the front end of the main frame through the king plate, which takes all of the draw-bar pull, strain and stress, and through its construction, relieves the king bolt entirely from any shear whatsoever; it merely acts as a tension member to hold the main frame in which the top half of the king plate is mounted in contact with the bottom half of the king plate mounted in the wishbone.

The channel-iron construction immediately underneath the main frame is termed the wishbone; on its two ends are mounted the steel spring-cushioned clamps. On the other end of the wishbone is mounted a 6-inch roller which is carried on ¾-inch ball-bearings and rolls beneath the flanges of a channel-iron quadrant placed transverse of the main trailer frame. Its main function is to carry the rear end of the wishbone, which carries 75 per cent of the load through the king plate and main frame of the trailer.

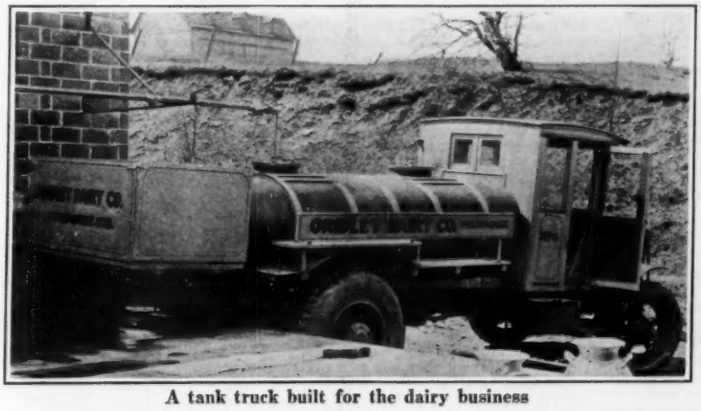
The steel clamps above mentioned are the flexible spring-cushioned connection between the trailer and tractor, which connects the trailer to the tractor, making them one unit.

The wishbone is so constructed and connected to the main frame of the trailer as to allow the tractor to turn either right or left without turning the main frame of the trailer until it comes to the point where the tractor started to make its turn, therefore producing the first two-wheeled trailer of dead-axle type that will follow in the tracks of the towing vehicle.

The main frame is 3 feet wide and 7 feet long, constructed of 6-inch standard channel-iron. It balances on the trailer axle so that a 3-yard gravity end-dump body, 3-yard gravity side-dump body, 6x10 platform-body or hayrack can be mounted thereon. The main frame is carried by a new innovation in spring suspension, the spring suspension consists of a cast-steel head fixedly riveted at either side to the main frame, which floats on three graduated coil-springs on either side of the frame, supported by the cast-steel bracket fixedly clamped to the square trailer axle. This construction is designed for a payload carrying capacity of five tons, of which 40 per cent is carried by the tractor rear axle through the wishbone. The trailer is fitted with indestructible steel wheels on which are mounted 6-inch tires. On these steel wheels are mounted the external band brakes which operate from the driver's seat. The trailer is also provided with adjustable screw-jack support, hinged underneath and toward the front end of the wishbone, which is hung up out of the way when the trailer is connected to the tractor.

Tank Trucks in the Dairy Business

MANY dairies throughout the country are dispensing with cumbersome milk cans by installing tank trucks. These are either glass- or copper-lined and are frequently insulated to prevent heating of the milk in summer, or freezing in winter. In fact, they may be compared, in a way, to thermos bottles.



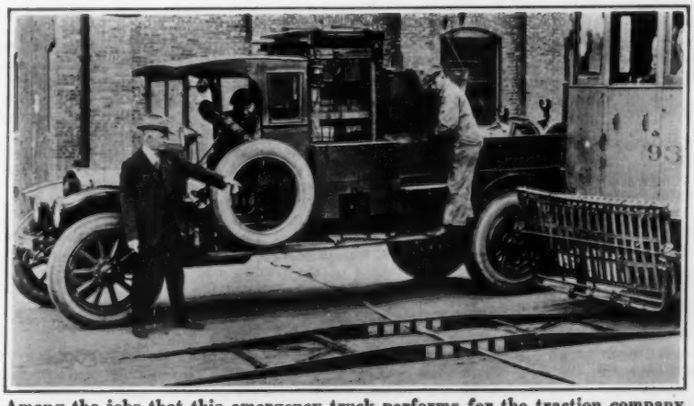
A tank truck built for the dairy business

The milk, of course, being cooled before it is piped in, increases in temperature but a degree an hour, even on the hottest day. Circumstances, naturally, govern the use of tank trucks. There are cases in which they relegate the old-fashioned can to the scrap heap and others in which they cannot be used economically.

If the capacity of any country plant can be carried in one or two trips by a tank truck, there is a worth-while saving of cans. Cans of eight gallons capacity cost around $6.50. Two hundred and fifty of them at this figure would cost $1625. It is necessary to have two sets of cans and some extras in handling milk, for while the empties are returning, the full ones are going in. Cans can be used for about four years. A tank should easily outlast them. The fact that the tank has a longer life than a set of cans is, however, of the least importance in deciding upon tank equipment.

The dairyman is engaged in supplying one of the vital necessities of human life. Upon the quality of the product he handles depends the health of millions of persons. The tank truck guards the temperature and therefore the quality of this product while it is being transported and in addition prevents the milk being contaminated by harmful foreign substances. This feature of the tank truck means as much to the dairyman as the practical savings in labor, time and equipment brought about by its adoption.

A Milwaukee dairy company has installed on the chassis of a new, specially designed pneumatic-tired truck a copper milk tank with a capacity of 840 gallons. The tank weighs 700 pounds when empty and 7924 pounds when fully loaded. A glass-lined tank of 800 gallons capacity weighs 2150 pounds empty. The truck is equipped with a rear box which can carry 22 8-gallon cans of milk in an emergency. This space is used to haul one ton of ice to the country receiving station on the return trip. Loading is done from three reserve vats at the country plant.



Among the jobs that this emergency truck performs for the traction company is the bridging of fire-hose that lies across the tracks

An Efficient Ally of the Street Railway

"PINCH-HITTING" for the street railway in Los Angeles, Calif., is the specialty of the two-ton truck, shown in the accompanying illustration, laying a temporary bridge over an obstructing length of fire hose. The bridge prevented a pile-up of street cars on either side of the hose. Another feat which the truck is frequently called upon to perform is the replacement of derailed cars. This it does by coupling onto stranded cars with a heavy log chain and towing the cars back to their tracks. The truck is also equipped with a three-section telescope tower designed to facilitate the repair of overhead wires. Other paraphernalia includes blocks, tackle, picks, shovels, jacks, crowbars, cables, ropes and lights, so that it can cope with almost any emergency.

Our Readers' Point of View

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Magnesium Alloys

To the Editor of the SCIENTIFIC AMERICAN:

I have read with interest the article on magnesium alloys in your paper of some time since, and would ask space for a few comments and strong protests against some statements in that article.

The magnesium alloys in question were *not* invented by the American company putting them out, and the idea of using these alloys for pistons and connecting rods in automobiles and airplane engines did *not* originate with this company. They are mere infringers of the patents of the undersigned.

The magnesium alloys were invented in Montreal by the undersigned in 1917, and were developed during 1917 and 1918, two years before the American company started their experiments. The idea of using a magnesium alloy for pistons occurred to me in 1917; and in spite of the advice I received from all my engineering friends, that the pistons would take fire and burn up on account of the high temperature (about 1500° C.) inside the cylinders (magnesium burns at 650° C), pistons and connecting rods were installed in one Buick engine and one Grant engine in the beginning of 1918. The results were so satisfactory that experiments were continued with several other engines, including one large 6-cylinder airplane engine of 5 5/16-inch bore. This airplane engine was fitted with both pistons and connecting rods, and at an official test showed an increase in power of more than 12 per cent over what it had with aluminum pistons and steel connecting rods. In the autumn of 1918 patents were applied for in all countries on the alloys, and patents were granted to me in the United States (1,341,774) and Canada (19,882) in 1920.

During the past year I have also tested the alloy for large raw-oil and Diesel engine pistons up to 12-inch diameter. The alloy stands up in these large pistons fully as well as in the smaller ones, and the advantages are even greater than in the automobile engines. In the ordinary one or two cylinder raw-oil boat engine the change of piston from cast iron to magnesium alloy increased the maximum power output by 50 per cent or more, and yet the engine, in spite of the higher speed, runs much cooler and with less vibration than before. Many two-cycle engines need to have water injected into the explosion chamber in order to keep them cool. This water injection is not necessary when using magnesium alloy pistons. On account of the high heat-conductivity of the alloy (three times that of cast iron) the piston, and thereby the whole engine, keeps cool in spite of the much higher power output. This should be of great importance, especially for the construction of Diesel and other crude-oil engines used for driving electric generators. On account of the relatively slow speed of such oil engines the generators have to be made very large and expensive. If the speed of the motor is doubled (and that can easily be done when using pistons and connecting rods of magnesium alloy) it is easy to see that the price of the whole aggregate will be greatly reduced. The wear and tear of bearings and cylinders of such a high-speed engine with the new pistons and rods is less than in the slow-speed engine with reciprocating parts of iron.

That the new alloy is the material par excellence for motor crank-cases hardly needs to be said. Unlike the aluminum alloys, which are rather brittle, the magnesium alloys are very tough and will stand up well against knocks and vibration. The hardest varieties of the alloy will bend and not crack, if the stress becomes too great. Elasticity varies to some extent with the hardness of the alloy, and the hardness again may be varied greatly by the composition and by working. As a rule the alloy contains over 85 per cent magnesium. In their elastic properties these alloys come nearer to wood than any other metal. On account of the low modulus of elasticity and the extremely great resilience, the alloy will stand vibration better than any other metal. It has, like wood, the property of giving way when stressed.

I have now succeeded in producing all kinds of structural shapes, such as channels, angles, I-beams, etc., in all sizes and lengths up to 30 feet or more, with tensile strength, 45,000 to 50,000 pounds per square inch; elastic limit, 30,000 to 40,000 pounds per square inch; elongation, 12 to 15 per cent, and modulus of elasticity, 5,000,000. By further rolling or hammering the strength may be brought up to more than 60,000 pounds per square inch, but then the elongation drops to about 1 or 2 per cent. If an alloy is desired with an elongation of 20 per cent or more this may be obtained by annealing after rolling, but then the strength drops to 40,000 pounds per square inch.

It will be noticed that this magnesium alloy in its physical properties is the equal of ordinary structural steel and yet weighs 4.4 times less. The alloy is in its worked form the only existing metal which has a greater tensile strength *in proportion to its weight* than the strongest woods (excepting such special steels as hard drawn piano wire). That magnesium alloys will be the material for the construction of airships and airplanes in the future seems certain. Even the airplane propeller may be made from this alloy and with the same weight it will have greater strength and far greater toughness than the present wood propeller. Many attempts have from time to time been made at producing metal propellers, but they have all failed for the simple reason that we had no metal strong enough in proportion to its weight. The centrifugal force tore the propeller to pieces. The magnesium alloy propeller is made in one piece and has the same shape as a wooden propeller except that it is thinner. It is cast with straight blades and afterward the whole propeller is hammered and the blades shaped to the correct pitch in the same way as we would hammer it to shape if it was to be made in one piece from steel. In hammering the magnesium alloy it must be kept at a temperature between 200° and 300° C.

The one great drawback with all magnesium alloys is that they are attacked by salt water, and must, therefore, where they are exposed to this, be painted, varnished or covered with some other metal by the Schoop method or protected in some other way. I have a short time ago discovered a simple way of treating the metal so that it becomes quite impervious to salt water. This new method of treating magnesium and its alloys, which, by the way, will be of great importance to the electrical industries, will be communicated later, when the patents are in order.

CHR. BACKER.

Bergen, Norway.

Helmholtz's Handbook of Optics

To the Editor of the SCIENTIFIC AMERICAN:

Many readers of the SCIENTIFIC AMERICAN will be glad to know that the council of the Optical Society has appointed a committee to make arrangements for bringing out an English translation of Helmholtz's great work on physiological optics.

The first edition of the "Handbuch der physiologischen Optik" was published in 1866, more than half a century ago; and the fact that this epoch-making work, which remains today the most original treatise on physiological optics, has never been translated into English, is a reproach to both Great Britain and America. To make its valuable contents accessible to those who do not find it easy or convenient to read a foreign language will be conferring a boon on many scientific investigators in the vast and expanding territory which this book was originally intended to cover.

Incidentally, the proposed English edition will be a memorial of the hundredth anniversary of the birth of Hermann von Helmholtz, whose influence on modern scientific thought in nearly every direction has perhaps been as widespread and permanent as that of any of his great contemporaries in the nineteenth century.

It is estimated that the cost of translating, editing, and publishing this memorial volume (or volumes) will be $5000 or more. It is particularly desired that every individual who is interested in the success of this project and in the advancement of the science of light and vision in this country will have an opportunity of contributing.

Contributions, no matter how small, may be sent to Adolph Lomb, Esq., treasurer of the Optical Society of America, care of Bausch & Lomb Optical Company, Rochester, New York. Make checks payable to "Adolph Lomb, Treasurer."

Anyone subscribing as much as $15 will receive a copy of the complete work when it is issued.

JAMES P. C. SOUTHALL,
President, Optical Society of America.

Uniforms and Clothes

To the Editor of the SCIENTIFIC AMERICAN:

In one of your recent issues I notice an article by E. C. Crossman on the subject of army uniform, and I wish to take exception to part of his article.

I wore this same uniform many months, myself, and will agree to some extent with Mr. Crossman's remarks regarding the blouse, but when he gets on to the subject of the trousers I fail to agree with him.

Mr. Crossman recommends that "long trousers (be issued) as articles of regular issue," etc. Of all the abominable garments designed for human wear long trousers head the list, in my opinion. They are neither becoming, sanitary nor comfortable, and only show that the male of the species is not far ahead of the female when it comes to being led like sheep. Any young boy in his teens has it in every way on an adult in the style of trousers he wears, and while the army style is not as neat as are the short trousers worn by boys, they were at least comfortable and a relief from the flapping pieces of cloth that we have to wear as civilians. Any golf player, any bicyclist or any athlete knows the superiority of knee pants in every way. With a lighter legging there certainly is no valid objection to the present style of army trousers, though I don't like the so-called "wrapped" leggings myself.

I, like all others, had to don "long pants" years ago and was well able to appreciate the change when I enlisted and got into O.D.'s—and it was with a real regret that I returned to the senseless and uncomfortable "long" trousers of the civilian.

If you want to advocate something, get a movement started to shake off the "long" trouser style that has endured simply because no one has had nerve enough to question it.

FRANK C. RUTLEDGE.

Pleasant Ridge, Ohio.

A Menace to Our Forests

To the Editor of the SCIENTIFIC AMERICAN:

One of the great constructive achievements of President Roosevelt is in danger. A serious attack on the United States Forest Service will soon be in the news from Washington. In the House the Curry Bill (H. R. 5964), in the Senate the King Bill (S. 2740), and the New Bill (S. 2382) provide for transferring the Forest Service in whole or in part from the Department of Agriculture to the Department of the Interior. Hearings have been held and will shortly be continued.

In the Department of Agriculture, where they are now, the Forest Service and the National Forests are safe and so well managed that (except for certain special interests) they have won the unanimous support of the nation. Their purpose is to grow trees, and they belong naturally in the department which has to do with growing all crops, including tree crops, from the soil. Forestry is a part of agriculture and is so recognized the world around.

The Interior Department is the real estate agent of the Government. It is not the business of a real estate agent to grow crops on forest or farm. As a matter of fact, when the Interior Department had charge of the National Forests, years ago, they were so badly handled that President Roosevelt was forced to insist upon their transfer to the Department of Agriculture. The modern progress of forestry in America dates from that change.

The Forest Service has little business with the Department of the Interior, and what it has is rapidly diminishing. It has many times more business with the other bureaus of the Department of Agriculture, and that business is rapidly increasing.

The Department of Agriculture has much forest work to do outside the National Forests. There are more acres by twenty million in woodlots on farms than in all the remaining public domain, of which the Interior Department has charge. If the Forest Service were transferred, the Department of Agriculture would be compelled to build up a similar organization, thus leading to more duplication in the Government service instead of less.

Forestry is doing admirably where it is. There is not one sound reason of any kind for the proposed transfer.

It is well understood in Washington that the same interests that attempted to gobble up the natural resources of Alaska in Secretary Ballinger's time are at it again. The best stalking horse of the men behind the grab is the claim that Alaska is going backward. The fact is that from 1910 to 1920 the exports from Alaska have increased from $13,608,394 to $62,469,006, or 366 per cent, while during the same ten years the exports from the United States increased from $1,866,258,904 to $8,228,016,307, or 340 per cent. Alaskan business has actually been growing faster than the business of the United States, although the latter has been increasing at a rate without precedent.

The National Forests in Alaska, if they can be saved, will produce two million cords of pulpwood annually for all time, or enough to supply one-third of the present needs of the United States. The Forest Service in the Department of Agriculture has completed plans for developing this great resource in a way to open it to the public but keep the grabbers out.

More than half our timber is gone already. Only one-sixth of our virgin forests remain, and they are being cut at a rate that will destroy them entirely before twenty-five years. Only a little more unrestricted forest devastation will bring down upon us the dangerous hardships of a timber famine. The cost of pulpwood and lumber is plain proof enough of the stage to which the scarcity has already advanced, and of what is still ahead.

Little has been heard of all this outside of Washington. The purpose of this letter is to let you know what is planned, and to express my hope that when the occasion comes you will treat the proposal as it deserves. Unless the friends of forestry take up this matter in earnest, its enemies will win out. If they do, it will mean the ruin of the Forest Service, the wreck of the movement for forest protection in America, and higher prices for forest products of every kind. It would seem to be the wrong time to take chances with forestry just now, when every clearheaded citizen knows that with the utmost care we can hardly escape most serious trouble from the exhaustion of our forest supplies.

GIFFORD PINCHOT.

Recently Patented Inventions

Brief Descriptions of Newly Invented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Apparel

TROUSERS.—J. H. BARNETT, 713 E. 6th St., New York, N. Y. This invention relates to trousers and also to wearing apparel, and has for its object to provide a construction of seam wherein an extra strip is provided which may be actuated for breaking the stitching of the seams without injuring the garment. Another object is to provide in a garment of any kind a ripping strip held in place by the same stitches that are used to hold the parts of the garment together.

GARMENT SUPPORTER. — T. L. CAUDLE, c/o Robinson, Caudle & Pruette, Wadesboro, N. C. Among the objects of the invention is to provide a device for supporting trousers, by use of which suspenders may be dispensed with entirely and a belt worn for appearance only, a supporter being provided made from resilient material and capable of being sprung and held into position between suitable buttons sewn at the proper places on the inside of the trousers.

GARMENT. — ANNA B. GRIBBIE, 80 Brandford Place, Newark, N. J. The invention relates to a combined dress and bloomers. Its object is to provide a garment more especially designed for children's wear and arranged to permit of quickly and conveniently donning the garment or removing it from the body of the wearer. Another object is to insure the utmost comfort for the wearer, in a garment of comparatively few parts.

Chemical Processes

PROCESS OF MANUFACTURING NEUTRAL COCONUT OIL.—W. S. COOKSON, c/o Lulu M. Smith, Maunawai, Oahu, Hawaii. An object of the invention is to provide a coconut oil which is neutral, odorless, and colorless. A further object is to provide a coconut oil of great purity which may be used for medical and toilet preparations, as well as for the manufacture of butter substitutes, and for edible purposes generally.

COMPOSITION OF MATTER FOR AND METHOD OF SOIL INOCULATION.—W. B. GUY, c/o Baldwin & Vetter, Jacksonville, Fla. The invention has for its object to provide a fertilizing composition, whereby the growth of vegetable and plant life is greatly enhanced. Besides its valuable property of liberating carbon dioxide in relation to the seeds and roots, it contains valuable food properties adapted to the sustenance of plant life. The composition comprises a formation of sucrose and yeast culture in dry powdered form to be mixed with the seeds and roots in the soil.

FIRE-EXTINGUISHING COMPOSITION.—M. R. RESANOVICH, 179 Hopewell Ave., Woodlawn, Pa. The object of the invention is to produce a composition which will be effective to quickly and completely extinguish fires, even though the fire be the result of the combustion of highly inflammable substances. The composition consists of a mixture of sauerkraut brine, skim milk, aluminum salt, salt, and hydrochloric or sulfuric acid.

COLLOIDAL COMPOUND OF ANTIMONY SULFIDE. — M. E. WOLVEKAMP, 1116 Second Ave., Oakland, Calif. The foremost object of this invention is to provide colloidal antimony sulfides which will be stable enough to allow of their solution being sterilized by boiling and which may be obtained as dry solids without dialyzing. As a protective colloid the sodium salt of a protalbinic or a lysalbinic is very suitable.

SOLUBLE COMBINATION WITH A COLLOIDAL SULFARSENITE. — M. E. WOLVEKAMP, 1116 Second Ave., Oakland, Calif. The object is to provide colloidal sulfarsenites which will be stable enough to allow of their solutions being sterilized by boiling and which may be obtained as dry solids by simple evaporation of their solutions without previously dialyzing away the electrolytes which may be present in their solutions as manufactured.

CHEMICAL COMPOUND. — M. E. WOLVEKAMP, 1116 Second Ave., Oakland, Calif. The present invention relates to improvements in antiseptics and its object is to provide an antiseptic that will serve as a substitute for mercuric salicylate, and that may also be used as a disinfectant for medical or other instruments. The compound is very easily soluble in a sodium chloride solution.

Electrical Devices

AUTOMATIC AWNING CONTROL DEVICE.—W. GREBLER and L. OSKOW, address Louis Oskow, 1725 Sterling Place, Brooklyn, N. Y. This invention relates generally to an electro-machine control system. An object is to provide with an awning, an electro-mechanical means for moving the awning and a system of control, whereby the awning may be automatically stopped at the limits of travel or may be held in any position intermediate the limits of travel, until again moved by the prime mover.

ELECTRIC IRON.—F. B. WIDMAYER, 65 W. 95th Street, New York, N. Y. An object of the invention is to provide means whereby the electric heating sections are automatically interconnected when the mechanical connection between the sections is established. A further object is to provide a construction so that if any particular heating element burns out it is not necessary to install a new complete unit but only to replace that particular section which is burned out.

BATTERY VISE. — H. G. LEFFINGWELL, 1155 Grand Ave., Grand Junction, Colo. The invention has for an object to provide a simple construction for holding a storage battery in position on a bench while being operated upon. A further object is to provide for holding the batteries in such way that the holding members are actuated by a foot pedal which will cause the battery to be firmly clamped against the bench.

ARMATURE WINDING MACHINE.—P. F. RHOADES and W. M. WELLING. Address P. F. Rhoades, 146 W. 21st Street, New York, N. Y. The invention relates to a machine in which an armature, with the commutator attached, can be rewound in a simple and efficient manner with a maximum saving of time and labor. Another object resides in the provision of means whereby with a simple adjustment a plurality of different types of armature windings can be made, and an accurate count of the number of armature turns wound at any particular instant may be made.

JAR CLOSURE.—A. W. KROWICKI, c/o Army and Navy Y. M. C. A., 226 Embarcadero, San Francisco, Calif. The invention relates in general to jar closures, but more particularly to a liquid seal for the cap closures for primary battery jars. An object is to so construct the seal that any gases which may be generated within the jar may readily pass through the seal into the atmosphere and at the same time provide an effective seal to prevent air from obtaining access to the interior of the jar.

Of Interest to Farmers

REVERSIBLE HILLSIDE TURNING PLOW.—S. LUTES, Primrose, Ky. The primary object of the invention is the provision of a plow adapted to be held in different positions so that only the extreme forward portion of the point will engage the ground and be subject to wear, and may be maintained in line with the land-bar or runner at all times, thereby producing an effective hillside turning plow, as well as insuring proper engagement with and turning of the earth.

POWER POSTHOLE AUGER. — L. J. HERDLITCHKA, Humboldt, Neb. The invention has for its object to provide an apparatus which is adapted to effect a rapid boring or drilling of postholes, which has a wide range of action and which is of simple and durable construction, reliable in operation, and easy and inexpensive to manufacture.

HAYRAKE.—W. KOUNS, Salina, Kans. The invention relates to a hayrake which can be attached to a vehicle body, such as a motor truck body. An object is to provide means whereby a rake frame can be attached to the front and rear of a truck, and can be raised from, and lowered to the ground, to receive the load of grain, and whereby the loads will balance with respect to the body of the truck, and may be easily and quickly transported.

SOIL TILLING MACHINE. — C. C. COOK, c/o Rindge Land Navigation Co., Stockton, Calif. This invention has reference to a rotating tiller having knives on its periphery which till the soil. An object is to provide an apparatus in which the weeds, corn stalks and other vegetation are first rolled flat and then cut into fine particles by the tiller which also tills the soil.

STUMP AUGER. — W. HUGHES, c/o Hughes Lumber Co., Meridian, Miss. The invention relates to hand-operated augers for drilling tree stumps, that they may be removed from the land either by burning or blasting. The object is to furnish a portable and collapsible construction capable of being readily transported, operated and adjusted, and in which the feeding of the auger can be controlled to operate and remove shavings from the hole bored. Cutting tools or drills of various size may be employed.

HONEYCOMB FRAME.—H. C. HARTMAN, Route No. 2, Braddyville, Iowa. An object of the invention is to provide means for holding the foundation web firmly in place within the frame so that it will not sag or sway from the weight of the bees thereupon. A further object is to provide a frame which will be simple and practical in construction, strong and durable in use.

BROODER.—H. J. WELCH, R. R. No. 1, Grafton, Ohio. The invention has reference more particularly to portable brooders in which no hovers are used, a proper circulation of air is maintained and the body portion of the chickens receive the necessary amount of heat. Another object is to provide a brooder which can be used equally well indoors and outdoors, having provisions against draft and abnormal winds, and is self-cleaning and provided with means to save the excrement for use as a by-product.

INCUBATOR TRAY.—J. KOVAR, address H. Zdavil, Taylor, Texas. This invention aims to provide an incubator tray which will provide means by which all of the eggs within the tray may be simultaneously and quickly turned, so that the expense, incident to the delay heretofore experienced in this operation will be eliminated, aside from the fact that danger of injuring the eggs will be precluded. The tray is extremely compact and capable of being manufactured at a nominal figure.

Of General Interest

SOCKET.—R. F. ARMSTRONG, La Cygne, Kansas. The object of the invention is to provide a device for use with artificial hands or the like, which evenly distributes the strain, incident to the securing of the artificial hand over the fore-arm and upper arm and without impairing the flexibility of the elbow joint, or otherwise interfering with the normal functioning of the arm, and which will not chafe or irritate the arm.

SCALE.—F. A. BURKHARD, 158 E. 82nd Street, New York, N. Y. This invention has for its object to provide a construction wherein a comparatively heavy or light object may be accurately weighed. A further object is to provide a scale having a plurality of springs and manually actuated means for throwing one spring out of operation and another in for working the same dial, the arrangement being such that one of the scales will accurately weigh heavy objects and the other light objects.

FIREPROOF DOOR.—A. V. KELLY, 780 St. John's Place, Brooklyn, N. Y. The invention relates to sliding doors commonly known as "fire doors." An object is to so mount these doors, which are constructed of heavy material, that they may be moved along a true horizontal track with little effort, and that they may be mounted to move to an inclined position in order that the door may automatically close.

WORK BENCH.—G. A. SCOTT, Marion, Ind. The primary object is to provide a bench designed for supporting a motorcycle at a convenient elevation above the floor while it is being repaired. A further object is to provide a bench which may be tilted to form a runway so that the motor cycle may be rolled upon the bench and the inconvenience of manually lifting the machine is done away with.

PLURAL STREAM DISTRIBUTING ATTACHMENT FOR SODA WATER DRAFT ARMS.—C. R. RAGSDALE, c/o Liquid Carbonic Co., 209 9th Street, Pittsburgh, Pa. The invention relates especially to a draft arm through which soda water is drawn. The special object is to provide a novel form of attachment with plural coarse stream nozzles as well as a separate distinctive element embodying fine spray nozzles, and for clamping said element detachably in position, as well as to provide for the effective control of the respective streams, to permit the operator to fill either one, two or three glasses at a time.

SCRUBBING DEVICE.—G. A. BLANK, 427 E. 139th Street, New York, N. Y. The invention pertains to a traveling platform upon which the operator may propel himself over the surface being scrubbed. Among the objects is to construct a device of this character in such a manner that the operator when kneeling upon the same will experience no discomfort. Ample water, brushes, soap and other necessities may be carried by the device.

COFFEE BREWING APPARATUS.—F. H. SIMONTON, 1207 Ogden Ave., Bronx, N. Y. Among the principal objects which the invention has in view are to provide means for brewing coffee or similar beverage in small quantities for individual consumption; to vary the strength and to proportion the quantity of the material from which the beverage is concocted to the demand for the beverage.

DETACHABLE HEEL.—H. S. ARAMIAN, 102 W. 102nd Street, New York, N. Y. The invention is particularly designed as a means for securing what are known as French heels to shoes. An object is to provide a simple, efficient and durable attaching means which does not materially add to the weight of the heel, which is entirely covered when the heel is in applied position and which affords means when removed to admit access being had to the interior of the heel to manipulate the tread fastening element.

CUFF BUTTON.—H. D. KANTOR, c/o Kantor & Lyons Co., 51 So. 2nd Street, Memphis, Tenn. This invention relates more particularly to cuff buttons which include separable members, the principal object in view residing in the provision of a member for effecting more readily the disengagement and separation of the members, and means connecting the same without directly forcing or straining them.

PEN.—R. P. STARKEY and G. C. RATHBUN, 773 Market Street, San Francisco, Calif. The principal object is to provide a lettering or drawing pen having an ink reservoir, and to provide means for keeping the ink from drying up in the reservoir so that it is unnecessary to fill and clean the pen each time it is used. A further object is to provide an adjustable holder which may be inclined at any angle, and the pen still present an upright position on the paper.

ROLL PAPER HOLDER.—E. D. CASTERLINE and J. A. BRIEN, 2471 Sacramento Street, San Francisco, Calif. The object of the invention is to provide a container for serving roll-paper tape, adhesive or non-adhesive, that will allow a strip of paper to be withdrawn in a convenient and easy manner. A further object is to provide a device which eliminates all possibilities of the paper curling up, and providing sufficient tension to insure against slacking.

COOKING UTENSIL.—J. H. CURTIS, 651 So. Clarence Street, Los Angeles, Calif. Among the objects of the invention is to provide a cooker which is adapted to maintain a relatively high cooking temperature when placed over a moderate supply of heat, and

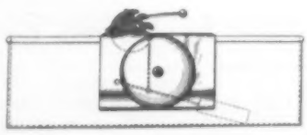


Fig. 1: Ice-pan signal invented by G. H. Bonekemper

Fig. 2: W. Celeda's self-cleaning smoking pipe

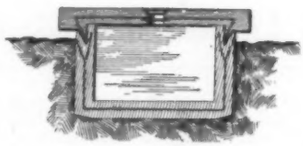


Fig. 3: Burial vault patented by J. T. Elmore

Fig. 4: Exercising apparatus put out by C. E. Lincoln

to provide a cooker in which the steam pressure will not exceed a predetermined degree, and in which the major portion of steam will be condensed and returned to the boiler portion insuring a long supply of water without replenishing.

COFFEE-MAKING APPARATUS.—G. ANSTON and G. P. PETROPULOS, c/o Geo. Anston, 810 Buckingham Place, Chicago, Ill. The principal object of this invention is to provide a manually controlled coffee-making apparatus in which a fluid is adapted to be passed over the coffee grounds and at the same time to entrain the coffee liquid that is below the coffee grounds to above the grounds, whereby the liquid will again pass through the grounds.

COT.—C. M. IRWIN and E. A. FISCHER, address C. M. Irwin, 1363 15th Ave., San Francisco, Calif. The invention relates to collapsible cots, the object is to provide a cot which when collapsed can be reduced to a bundle of small size such as can be easily carried in an automobile. The main feature of the cot is its joints, which, although collapsible, are perfectly rigid when assembled and do not even suggest that the cot is collapsible.

DEVICE FOR FEEDING COMPOUNDS IN WATER SYSTEMS.—P. SEVCIK, 1416 N. Lawndale Ave., Chicago, Ill. An object of the invention is to provide a device for feeding compounds to the liquid in water systems for the purpose of purifying the water, for preventing the accumulation of scale on the apparatus. A further object is to provide a device which can be operated at will, and which, when operated, will not interfere with the functioning of the system to which it is applied.

SIGN SUPPORT.—G. H. POWER, 508 W. 12th St., Tulsa, Okla. The primary object of the invention is the provision of a support for signs permitting of limited swinging movement in such manner that the sign may be effectively and advantageously displayed and will be capable of movement under the effect of air currents to attract the attention of those within view of the same.

PLASTIC-BLOCK MOLD.—E. J. BENSON, 137 S. Los Robeles Ave., Pasadena, Calif. The purpose of the invention is the provision of a mold which is capable of forming a block with ducts extending completely through the body of the block and grooves in the side of the block, such grooves being designed to receive and effectively secure plaster when applied to the side of the block.

PNEUMATIC CUSHION.—J. J. HALLORAN, 212 Woodrow St., Daly City, Calif. The object of the invention is to bring about a cushioning effect by constructive features rather than the qualities of the material used. A further object is to provide a cushion that will adapt itself to a wide range of uses whether it be as a unit to ease the slamming of a door, or as a combination of units to give resilience to the running-board of an automobile, or the heel of a shoe.

SOAP-DISPENSING DEVICE.—L. B. SCHWARCZ, 1245 Madison Ave., New York, N. Y. Among the objects of the invention is the provision of a simple and economically manufactured liquid soap-dispensing device, in which the body portion and cover are so connected together that the connections cannot be tampered with by persons using the device. The receptacle is ornamental in its design.

CEILING FAN.—M. M. GLASSER, 42 Lawrence St., Charleston, S. C. The object of the invention is to provide a fan wherein the blades in addition to their rotary movement have vertically swinging or oscillating movement imparted to them during their rotation, and controlled by their rotation for distributing the current of air thrown by the blades over a large area.

COVER FASTENER.—C. H. BALKNAP, 1373 President St., Brooklyn, N. Y. The invention relates especially to fastening devices adapted for pinning in position bed clothes. An object is to provide a fastening device for bed covers wherein the fastening members are allowed a yielding movement so as to give when there is a pull on the covers within certain limits. The fastener comprises a pin, and a special tube for receiving the pin.

LUMINOUS LETTER.—J. P. SHERIDAN, 8 W. 104th St., New York, N. Y. The object of the invention is to provide means for making luminous figures that are legible in the dark for some considerable distance. The object is accomplished by providing a foundation colored to form a suitable background, and painting the figures with a luminous compound, and a strip of radium luminous paint to define the shape.

VANITY CASE.—W. G. KENDALL, 118 Market St., Newark, N. J. Among the objects is to provide a vanity case whereby the interior is divided and means are provided for securely holding two porcelain or similar disks for carrying different cosmetics. Another object is to permit of readily placing a partition in position in the case and securely holding it therein without cement or adhesive material.

FOLDING CHAIR INTERCHANGEABLE FOR USE AS CHAIR OR BACK SUPPORT.—J. A. BELL, Eddington Street, North Rockhampton, Queensland, Australia. The invention relates to a metal folding chair with flexible seat which can be altered when required to use as a legless chair, such as for placing on forms or benches to constitute a back support. A special feature is that the parts are constructed and adjusted so that the article can be used with or without legs at option. It is also readily portable and can be folded up into very small space.

CONCRETE FORM.—W. J. PEDERSEN, address Helen Marsh, 347 Fifth Ave., New York, N. Y. An object of the invention is the provision of a concrete form or mold so constructed that columns may be simply and quickly formed with a minimum expenditure of time, and by an unskilled workman. Reinforcing material, such as rods or wires, may be inserted within the mold, and the columns formed may be readily removed from the mold without injury to their surfaces.

EGG BREAKER AND SEPARATOR.—J. A. BECKER, Box 361, Nampa, Idaho. The invention relates to a device which is adapted to cleanly and sharply break the shell of the egg, which provides a receiver for the yolk and white of the egg, and means for separating the yolk from the white when desired, and which is in general of simple construction and reliable and easy to operate.

NURSING BOTTLE HOLDER.—W. H. SAUNDERS, 4287 Boston Post Road, East Chester, N. Y. The invention relates to supports adapted for use in connection with nursing bottles. Among the objects is to provide an attaching device of a resilient and adjustable nature in order that the bottle may be properly positioned, and to provide a clamp which is capable of holding bottles of various sizes. The device is capable of attachment to a child's carriage or crib, or various articles of furniture.

BRACKET.—C. M. COX, Straight, Pa. The invention relates to brackets especially adapted for supporting mirrors. An object is to provide a bracket which is capable of a variety of adjustments so that the mirror supported thereby may be conveniently positioned with relation to the light and to the user. The device may be conveniently applied to the wall without in any way marring the appearance of the wall.

BOAT CONSTRUCTION.—V. S. DOWNING, c/o Jackson Board of Trade, Jackson, Miss. A purpose of the invention is the provision of a boat having an air duct and air channels formed in its hull which are so shaped and positioned as to effect a lifting and propelling action to the boat when air is forced rearwardly through the duct. The construction of the hull is such that the boat as an entirety is caused to ride substantially upon a film of air.

ICE-PAN SIGNAL.—G. H. BONEKEMPER, 137 Hazel St., Paterson, N. J. The object of this invention is to provide a simple device which can be readily attached as a unit to an ice pan to cause the giving of an alarm when the liquid level within the pan reaches a predetermined height. The whole device can be attached to the pan merely by sliding it over the edge, means are provided whereby a plurality of signals are successively given as the water rises. (See Fig. 1.)

HAT HOLDER.—J. P. GLENN, address, c/o News Print Co., Fort Pierce, Fla. Among the objects of the invention is to provide a device adapted to be secured to the under face of an automobile top and to conveniently engage the brim of a hat to support the hat in inverted position, and to provide a device which will be neat and attractive in appearance, and will take up very little room.

PHRENOLOGICAL CHART.—F. C. NEWELL, JR., c/o Frank C. Reilly, 1457 Broadway, New York, N. Y. This invention has for its object to provide a chart with a plurality of rotable members or cards each having illustrated thereon similar portions or sections from a member of different types of heads so that the members may be rotated relatively to each other to bring into position selected portions or sections on the members or cards to form a complete head. Another object is to print on the cards information explaining the personal characteristics.

CAN COVER.—H. P. CIESIELSKA, Bear Valley Ranch, San Niguel, Calif. The invention relates to covers for milk cans such as are commonly sold containing condensed milk. The object is to provide a convenient form of cover for such cans which can be used as a protector to keep the can air tight, and the milk in good condition, after it has been opened. The cover provides means whereby the can may be closed immediately after milk has been used.

SHIPPING CASE FOR LINOTYPE COMPOSITION.—E. P. COTTERMAN, 522 So. Main St., Wichita, Kans. An object of the invention is to provide a shipping case which can be conveniently operated to receive the linotype composition, retain them properly packed during transportation, and readily and easily release them when they reach their destination. A further object is to provide a device which can be reused, which is durable, and easy and inexpensive to manufacture.

DRINKING FOUNTAIN.—C. O. COWAN, 208 Jackson St., Seattle, Wash. A purpose of the invention is to provide a drinking fountain of simple construction which is readily attachable to or detachable from a faucet of ordinary construction. A further object is to provide a device which is adjustable to allow for different water pressures, whereby a proper flow of water is insured irrespective of the water pressure.

RECEPTACLE.—R. L. SADDLEMIRE, 821 Crane St., Schenectady, N. Y. This receptacle is particularly adapted for use in connection with preserving, but may be utilized for any suitable purpose, where air tight receptacles are required. The object is to provide structure including an air tight seal which shall effectively guard against any deterioration of the contents of the receptacle, a removable bail and lever being so constructed that the receptacle and cover may be cleaned with ease.

MOTION PICTURE CAMERA.—L. S. UHLER, 543 Napoleon St., Detroit, Mich. One of the foremost objects of the invention is to provide a motion picture camera whereby exposures can be made either at the ordinary rate of sixteen per second or at the rate of only two per second, the latter producing an artifice in the resultant exhibited picture, commonly known as a "trick" picture. A further object is to provide means for automatically opening and closing the shutter.

SMOKING PIPE.—W. CELEDA, 489 S. 15th St., Newark, N. J. The invention relates to a pipe having means to catch the nicotine and prevent the direct passage of the smoke from the bowl to the mouthpiece, thereby keeping the pipe thoroughly clean. The general object is to provide a nicotine chamber so arranged relatively to the stem and mouthpiece as to insure the settling and deposit of the nicotine, and to prevent the passage of saliva to the bowl, and cause the smoke to be cooled. (See Fig. 2.)

BURIAL VAULT.—J. T. ELMORE, 743 College St., Jacksonville, Fla. An important object of the invention is to provide a reinforced concrete burial vault in which the parts are so constructed, arranged, and related as to be susceptible to easy and ready assembly to present a very substantially unitary and hermetically sealed structure, having the qualities of great strength and durability. The hermetic seal may be readily broken from the outside when necessary. (See Fig. 3.)

EXERCISING APPARATUS.—C. E. LINCOLN, Box 24, Station A, Boston, Mass. An object of the invention is to provide a resilient device in the form of a pair of pneumatic balls which may be held in the hand of an operator and squeezed to exercise the muscles of the fingers and wrist. Another object is to so construct the apparatus that it may be conveniently carried in the pocket of the user, and will be simple and practical in construction and durable in use. (See Fig. 4.)

PIPE WALL SCRAPER.—W. F. GANSTER, 2105 Metropolitan Ave., Middleville, Queens, N. Y. The object of the invention is to provide a scraping device for the walls of smoking pipes which can be automatically adjusted to fit different size pipes and which may be readily operated for scraping the walls evenly without injury to the pipe. A further object is to provide a scraper in which a minimum number of parts are used with an arrangement which is simple and strong.

Hardware and Tools

PLUMB AND LEVEL.—W. BENGEL, Newport, Ark. The object of the invention is to provide an arrangement including a gravity controlled pendulum by means of which in connection with a graduated ring a practically unbreakable level may be formed which will be unaffected by climatic changes and by means of which a level or indicated degree of inclination may be accurately determined at all times without the necessity of adjustment of parts.

COMBINED DRILL AND REAMER FOR PEARL BUTTONS.—P. F. DUSHA and A. FEYK, c/o Holub Dusha Co., 1700

1st Ave., New York, N. Y. Among the objects of the invention is to provide a combined drill and countersinker, and means for holding the two together, for making and finishing of a buttonhole in a single or continuous operation. A further object is to provide a tool of such character as to enable it to be maintained sharp automatically.

SPADE.—F. B. CURRIER, 356 Rockwell St., Long Branch, N. J. The invention particularly relates to a type of spade used in connection with handling salt marsh sod. An object is to provide a spade which shall be extremely rigid in construction, so that no play will exist between the parts, which shall weigh but a fraction of the weight of tools commonly used for this purpose, and at the same time permit of cutting and removing the sod in an efficient manner.

WATCHMAKERS' COMPOUND LATHE CHUCK.—A. GOTSDANKER, 734 Grand St., Brooklyn, N. Y. An object of the invention is to provide a lathe chuck in which the work is held securely in a clamping plate which in turn is clamped between the jaws of the chuck so that a larger portion of the work may be placed inside the chuck while the smaller portion of the work is on the outside of the chuck in a position convenient for the turning operations.

COMBINED DRILL AND REAMER.—J. P. FULLILOVE, 1825 Fairfield Ave., Shreveport, La. Among the objects of the invention is to provide a combined drill-bit and reamer comprising a blade or plurality of blades normally housed within the outer walls of the drill-bit and so arranged that they may be forced outwardly beyond the plane of the wall of the bit-head to enlarge or undercut the hole made by the bit.

BLACKSMITH'S TOOL SET.—A. L. LEGON, Box 447, Fort Stockton, Texas. It is the object of the invention to provide a tool set or detachable handle for tools by which various types of tools, such as a hammer, swedges, hatchets, claw-hammers, and the like, may be readily applied and held, thus necessitating but a single handle for numerous tools, while also adapting the device to be made in various sizes for use by mechanics generally, according to the work to be executed.

LOCKING DEVICE FOR TURNBUCKLES.—C. F. JAYNES, 1724 11th Ave., Seattle, Wash. The purpose of the invention is to provide a simple and inexpensive locking device by means of which the turnbuckle is locked to prevent spreading of the parts united by the buckle. The device is especially adapted, although not necessarily so, to turnbuckles employed to adjustably connect the brake-rods or other parts of a railway car.

SCRAPER GUARD AND SHARPENER.—W. J. WERNER, 867 Sedgwick St., Ridgewood, L. I., N. Y. The invention has for its object to provide a construction which is automatically adjustable to suit the hand of any operator. Another object is to provide a guard which is slidingly positioned on the scraper so as to be readily adjustable and at the same time protect the fingers of the operator against injury.

Heating and Lighting

DAMPER.—J. TANDY, c/o Apex Fireplace Co., Box 454, Urbana, Ill. The invention relates to fireplace dampers, and has for its object to provide a construction adapted to control the draft wherein a housing is provided of a size to register with the opening of the flue, and shaped to conform with the junction of the fireplace and the flue, and having a damper capable of being operated from outside the flue for regulating the draft.

DRYING APPARATUS.—W. WURL, Weissensee, Berlin, Germany. This invention has for its object to provide a construction for drying granular material in a continuous operation. Another object is to provide an apparatus with stirring and conveying means, in which the drying medium enters at one side and leaves at the opposite side while the material being dried is forced longitudinally of the apparatus and transversely of the movement of the drying medium.

HEAT INSULATING COVERING FOR PIPES.—C. DOINO, c/o Clarke, 44 Maujer St., Brooklyn, N. Y. The invention more particularly relates to heat insulating covering for steam, hot water, and similar pipes. The prime object is to so construct the coverings as to greatly facilitate the rapidity with which they can be manufactured, thus reducing the cost as compared with coverings as at present used.

SUPPORT FOR COLD-AIR REGISTERS.—J. E. HUG, 511 E. 22nd St., Indianapolis, Ind. The invention relates to cold-air registers used in connection with hot-air furnaces. The object is to provide clips which may be easily positioned for supporting a register within an opening in a floor, and also to provide for the easy removal of the register when desired.

VALVE.—P. J. HUBIN, 86 Hadley Ave., Clifton, N. J. The object is to provide a thermostatic or automatic air valve for use on radiators of steam heating systems so as to permit the air in the system and particularly in the radiator to escape to facilitate the entrance of steam and hasten the heating action, and to close under the action of heat from the steam, so as to prevent the escape thereof, thereby insuring a most efficient heating action.

Machines and Mechanical Devices

APPARATUS FOR HANDLING MATERIALS.—F. H. MCCONNELL, 1117 2nd St., S. W., Roanoke, Va. The invention relates to a device for handling materials of various characters, particularly sand, cement, stone and like materials in mixing concrete. A purpose is to provide an apparatus which will facilitate the handling of materials in large quantities, it being operable to discharge predetermined quantities from a bin to a plurality of points to allow of the simultaneous filling of a plurality of receptacles. (See Fig. 5.)

WINDING DRUM.—L. C. MILES, 1503 No. 25th St., Boise, Idaho. The object of the invention is to provide a drum with lagging sections made of different thicknesses so that when placed upon a drum they may have different diameters, and thus be suitable for making the drum adapted to perform different classes of work; that is, a small diameter for lifting a heavy load and a larger diameter for lifting a lighter load.

PISTON.—T. G. SAXTON, Boonton, N. J. The invention relates to a piston so constructed that it provides a medium whereby any wear incident to a moving engagement between the piston and the cylinder will be reduced to a harmless factor. A further object is to embody a wrist pin in which the wear will be evenly distributed, and reduced to a minimum.

EXPANDING APPARATUS WITH AUTOMATIC STOPPING AND ADJUSTABLE ACTION.—H. E. A. GALLON, 25 Rue de Pontoise, Herblay, Seine-et-Oise, France. This invention relates to an apparatus for expanding tubes and ferrules, and comprises a rotary tool-carrying spindle, means for rotating the spindle and causing it to progressively move forward, said means including a spring connected to the spindle and means for arresting and retracting the spindle when a predetermined pressure is reached.

MECHANICAL INDEXING MEANS.—J. E. MACK, c/o Nassau County Sanatorium, Hicksville, N. Y. The invention relates to a simple and readily expansible indexing system having digits representing the consonant outline of indexed matter and corresponding to the letters of such outline in groups of letters, according to the relative frequency of the occurrence of such letters in average word construction.

LOGGING DEVICE.—D. G. MANGES, c/o Lidgewood Mfg. Co., 96 Liberty St., New York, N. Y. An object of this invention is to provide mechanism in connection with a power-operated logging device for permitting a series of drums to be operated from a single engine. A further object is to provide an adjustable bed frame for the engine to permit the drums to be readily alined with the sheaves and spar.

Musical Devices

ATTACHMENT FOR PHONOGRAPHS.—J. R. MCPHILLIPS and H. S. BOWES, c/o M. P. McDonagh, 425 Richmond St., London, Ont., Canada. The object of the invention is to provide a device which is especially adapted to carry the reproducer when it is disconnected from the tone arm in such a manner as to relieve its elements of any stresses which would tend to impair its reproducing qualities, which provides containers for phonograph needles, and which may be used with different styles of cabinets.

SOUND REPRODUCER.—F. PETMECKY, c/o The Petmecky Co., Austin, Texas. The invention relates to a stylus bar and mounting therefor which permits a turning or rotary adjustment so that the sound or tone can be varied, and also permits the sharpening of the needle. An object is to provide a device which not only permits economy, but also so mounts the stylus that its various positions of adjustment result in a varying sound production.

REPRODUCER FOR PHONOGRAPHS.—W. E. HUNT, Silver City, Mexico. An object of the invention is to provide a reproducer by means of which a perfectly clear, distinct, loud and natural tone is secured, and in which the so-called mechanical noises and the nasal twang are eliminated, and the lapping of sounds caused by echoes is obviated and the loudness of sound increased. A further object is to provide a novel means for holding the needle in the stylus bar.

FASTENER.—J. GAYNOR, 67 College St., Jersey City, N. J. This invention has particular reference to means for fastening the body portions of casings of musical instruments. An object is to provide a fastener which, in a simple manner, not only fastens the closure but saves as a metallic reinforcing element and grips the body portion along its edges to provide rigid space relation between the closure and the body portion.

Prime Movers and Their Accessories

SELF-ALIGNING CONNECTING ROD.—J. E. CROWELL, Matthews, N. C. The foremost object is to provide a flexible connection between the piston and crank shaft so that the piston and connecting rod, in which the flexible connection is located, will always be free to line up with the engine cylinder regardless of any inaccurate aligning of the crank shaft, a condition often brought about by badly fitted or worn bearings. The invention relates to internal combustion, as well as other types of engine.

SPEED CONTROL DEVICE FOR INTERNAL COMBUSTION ENGINES.—F. J. BRUMME, Lowe Farm, Box 126, Manitoba, Canada. Among the objects of the invention is to provide a device designed to be applied to an internal combustion engine of a standard or ordinary construction, and which will be operated automatically when the speed of the engine exceeds a predetermined rate to control the valve in the carburetor of the engine and thus insure the operation of the engine at uniform speed.

GOVERNOR.—R. ESPIE, Mount Carroll, Ill. The invention relates particularly to a governor for marine engines for automatically actuating a throttle of the engine when the propeller rises and ceases to impart the normal propulsion to the shaft. The primary object is to provide a governing device for automatically throttling the engine when the propeller is raised out of the water and thus permitted to race, due to the vessel being abnormally rocked by a heavy sea. (See Fig. 6.)

INTERNAL COMBUSTION ENGINE.—B. L. CAMPBELL, 60 E. Chicago Ave., Apt. 4, Chicago, Ill. An object of the invention is to provide a two-cycle engine in which the necessity for crank case compression is obviated. A further object is to provide a device having a fan mounted on the crank shaft and serving as a fly wheel in addition to performing its function as a means for causing a circulation of air through the jacket of the cylinder and forcing air into contact with an inflammable liquid to form an explosive mixture for driving the engine.

FAN DRIVE.—V. W. PAGE, c/o Page Motor Corp., 309 Lafayette St., New York, N. Y. The invention pertains more particularly to cooling fans for internal combustion motors. Among the objects is to provide a gearing for driving the cooling fan of a motor vehicle motor in lieu of the belt drive commonly used in this connection. A further object is to operate the fan driving gearing by the same power transmission element as furnishes the power for the cam shaft of the motor.

CIRCUIT CONTROLLER FOR IGNITION SYSTEMS.—J. H. STEARNS, c/o Wash. Missionary College, Tacoma Park, Washington, D. C. An object of the invention is to provide a device designed to be automatically controlled by the pressure of oil in the lubricating system, to short circuit the ignition and stop the motor when the quantity of oil is low, making it impossible for the motor to run without sufficient lubricating oil, and thus prevent burnt out bearings. The device also gives a visual indication as to the position of the circuit controller. (See Fig. 7.)

COOLER FOR INTERNAL COMBUSTION ENGINE RADIATORS.—S. BARUCH, 133 Mercer St., New York, N. Y. The object is to provide an inexpensive cooler having a drum in which extends a perforated tube connected with the interior of the radiator, so that the steam may pass upwardly and through the perforations where it will be cooled by the air which will flow upwardly in the radiator overflow pipe to the drum, the condensed steam flowing back through the lower perforations in the tube and into the radiator.

HOT AIR REGULATOR.—G. P. B. HOYT, 1 Clinton Place, Jamaica, N. Y. The object is to provide a hot air regulator for internal combustion engines arranged to control the temperature of the hot air passing into the carbureter to insure the formation of a proper explosive mixture for effective use in the engine cylinders. Another object is to compensate for the difference in the temperature of the atmospheric air drawn into the carbureter during different parts of the day, or when traveling over hills or through valleys.

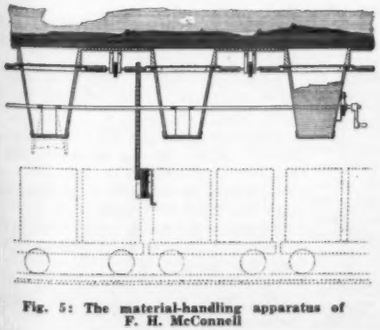


Fig. 5: The material-handling apparatus of F. H. McConnell

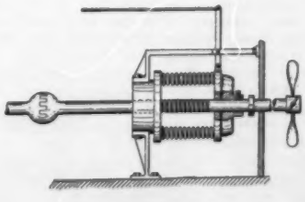


Fig. 6: Marine-engine governor invented by R. Espie

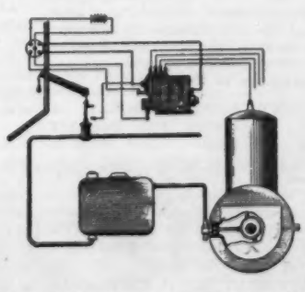


Fig. 7: Ignition-circuit controller patented by J. H. Stearns

VALVE GRINDING TOOL.—H. GARTELMAN, 32 Hildreth Place, Yonkers, N. Y. The primary object of the invention is to provide a tool especially adapted for grinding the valves of internal combustion motors, in which the shank of the tool will be given a partial rotation in opposite directions in an intermittent manner. A further object is to provide a tool which will be simple in operation and durable.

Railways and Their Accessories

ADJUSTABLE RAIL BRACE.—J. L. BEIL, 302 Main Street, Galena, Ill. The invention relates to a railway switch construction, an object being to provide a device for bracing the rails of a switch to more effectively prevent the spreading of the rails in service. A further object is to provide a device having means for adjusting the rails to move the same toward the initial position when they have been moved apart. The device may be employed in connection with standard rails and other switch parts.

CAR TRUCK.—S. B. BRILHART, 214 W. 27th Street, New York, N. Y. Among the objects of the invention is to provide a car truck frame and anti-friction rollers journaled to the frame, means for pivotally connecting the car bodies together, and for preventing undesirable lateral movement between the body connecting means and the central truck beneath, so that the car sections may swing laterally with respect to each other as a result of either lateral curves or vertical depressions in the track.

TIE PLATE.—J. D. TUSAR, Forest City, Pa. An object of the invention is to supply a device which will provide a relatively wide bearing surface for railroad rails, and which is provided with integral means for preventing its displacement upon a tie. A further object is to provide a tie plate which is simple and durable, and which will tend to lengthen the life of the tie.

WEED AND GRASS CUTTER FOR RAILWAYS.—T. W. KELLY and C. TINGLE, c/o Clem C. Countiss, Belton, Texas. The general object of the invention is to provide a cutter in which the cutting element of the driven cutter will be flexible to remove weeds and grass by a brushing action. A further object is to utilize lengths of cable as the cutting elements and to provide an effective assemblage of said elements as well as means to firmly clamp the same.

RAILROAD SPIKE.—A. PLUMP, 420 Maple St., Redwood City, Cal. The invention has for its object to provide means in connection with a spike for firmly holding the spike in place against the possibility of accidental displacement or loosening. The spike is provided with a groove extending from the head on a continuous curve; into this groove a heavy nail is inserted, driven two-thirds its length, and then bent over the top of the spike head. The curved groove will force the nail into the tie material, thus anchoring the spike.

RAIL SUPPORTING ELEMENT.—A. H. ANDERSON, 1024 Chamberlain Ave., Fairmont, W. Va. The object of the invention is to provide a self-locking tie for mine and industrial purposes, which is light in construction, has no loose parts, may be easily manufactured of wood and steel combined, when the use of steel ties is not feasible, which is easy to lay, requiring no tools and avoiding the necessity of using wooden blocks, bolts or other accessories for fastening the tie to the rail.

DOOR-OPERATING APPARATUS.—E. H. GRIM, Box 91, Dott, W. Va. The invention relates more particularly to an apparatus for opening and closing a door at the entrance of a mine or tunnel through which railway cars pass. The object is to provide means by which the door will automatically open when the cars approaching have reached a predetermined distance, and upon the passage of the cars through the entrance the door will be again automatically closed.

Pertaining to Recreation

AMUSEMENT APPARATUS.—E. A. DAY and A. W. WHITE, P.O. Box 107, Odanah, Wis. The primary object of the invention is to provide a device which is designed to test the skill of a contestant, in maintaining his equilibrium. The object is to provide an apparatus which will closely simulate the usual log rolling contests. The device includes a cylindrical member rotatably supported over a safety net.

GAME APPARATUS.—P. D. RIORDAN, 131 East 86th St., New York, N. Y. Among the objects is to provide by means of a series of regular geometrical figures outlined, preferably in the national colors, of a designated country, State or foreign possession, an interesting pastime, instructive in its geometrical illustrations of circles, radii, arcs, and sectors of concentric circles, as well as in its political and historical information and in the patriotic motive of its color scheme.

Pertaining to Vehicles

RESILIENT WHEEL.—H. T. EVANS, Manhasset, N. Y. The primary object of the invention is to provide a non-pneumatic wheel which embodies the same resiliency and shock-absorbing qualities as a wheel equipped with a pneumatic tire, in addition to eliminating the disadvantage attendant upon pneumatic tires. The wheel consists of standard interchangeable parts, capable of replacement when worn or broken, and it may be readily disassembled for cleaning or repair.

SLEIGH RUNNER FOR MOTOR VEHICLES.—H. T. MILLER, 157½ Henrietta St., Rochester, N. Y. The purpose of the invention is to provide runners adapted to be attached to the front wheels of a motor vehicle to facilitnte its traveling through snow of considerable depth, the runners sliding over the surface and packing the same beneath the wheels so that a firm bed is provided for the rear wheels of the vehicle.

SEAT.—R. M. MONTGOMERY, 47 Bellevue Ave., Pontiac, Mich. The invention particularly relates to seats employed in connection with automobiles or other vehicles. The object is to provide a seat of such construction that the sides and back are freely movable with the seat when the seat is moved upwardly or downwardly under the action of the springs associated therewith.

CHANGE SPEED GEARING.—J. B. ROWE and A. G. BARRATT, address D. Young Co., 57 Chancery Lane, London, England. The invention relates to speed gearing in which the gear ratio is made continuously variable by means of an auxiliary variable friction gear, the purpose being the provision of a simple mechanism in which the moving parts are subjected to comparatively little stress and will accordingly wear well.

HEADLIGHT.—H. R. LOTZ, Military Department, Iowa State College, Ames, Iowa. The invention resides in a post for supporting the headlight to be turned, the post being formed with a tubular body in which an inner tube fitting snugly therein is adapted to turn, a lamp bracket being suitably mounted on the upper end of said tube, the electric conductor cord passing through the inner tube.

CONTROLLING DEVICE.—F. A. MCDANIELS, 1253 Minnesota Ave., Portland, Oregon. The invention relates to control levers for self-propelled vehicles or tractors of the type which embodies a single motor and mechanism for independently or simultaneously coupling the driving elements thereto. The invention primarily contemplates the association of a plurality of levers with independent connections whereby the levers may with convenience be independently or simultaneously operated and retained in any one of their adjusted positions.

TRANSMISSION GEAR.—C. BEARENS, 106 Bank St., New York, N. Y. The invention relates to a gear embodying means whereby to effect an automatic gear shift so that in overcoming inertia in starting or in overcoming resistance as in hill climbing, or otherwise running under a heavy load, under direct drive and high speed, should the speed be too high for starting or overcoming resistance without shock, the gearing will be automatically thrown out of high gear and into low gear.

AUTOMOBILE RADIATOR.—A. FROST, Bellevue Hospital, New York, N. Y. Among the objects of the invention is to provide a radiator, or what is the equivalent of an ordinary radiator, having the property of bringing the cooling air into direct contact with the water in the form of a fine spray or mist whereby the greatest cooling effect is accomplished. Another object is to provide means for varying the rapidity of circulation of the water so as to control the degree of cooling of the water according to the variations of the temperature.

ACCESSORY FOR MOTOR TRUCK.—C. S. WEIMER, 26 Caspian St., Elizabeth, N. J. The invention particularly refers to a device for extricating a vehicle which is mired or stalled, but is capable of a number of uses as part of the emergency equipment, and may be employed as a skid board for loading or unloading the truck, or a towing means. Preferably the equipment consists of two specially constructed skid boards, and two chains which may be employed for anti-skid purposes on the wheels, or for towing.

SIDE WIND DEFLECTOR.—H. and L. BENZER, 141 Roebling St., Brooklyn, N. Y. It is the primary object of the invention to so construct side wind deflectors that a reflecting mirror may be attached to the transparent material, to take the place of the ordinary reflecting mirror as separately attached. The mirror of each wind deflector may be adjusted to reflect the presence of vehicles at the rear.

TRUCK AND TRAILER COUPLING.—J. W. BULLER, Hillsboro, Kan. The general object of this invention is to provide a coupling of the ball-and-socket type, the socket being composed of members one movable relatively to the other, for quickly coupling and uncoupling. An important object is to provide a lubricating means for the ball and socket so that not only will the ball be lubricated at its contact with the upper socket member, but the oil will pass through the ball to the lower socket.

EMERGENCY TIRE FOR AUTOMOBILES.—J. H. SKOGMAN, 1514 Moffett Ave., Joplin, Mo. An important object of this invention is to provide an emergency tire which is capable of ready attachment to a vehicle wheel for the purpose of displacing the original tire should the same become punctured. A further object is to provide an emergency tire which, when not in use, may be completely folded up and carried in one of the storage compartments.

FLOAT-CONTROLLED ENGINE SHUT-OFF.—B. S. WILLIAMS, 416 Deaderick St., Nashville, Tenn. The invention relates to automobile and other engine-controlling apparatus. One of the foremost objects of the invention is to provide means for automatically stopping an engine, when the fluid vital to the operation of the engine becomes exhausted to a predetermined degree. A further object is to provide an automatic cut-off for the engine controlled by a float in the oil reservoir.

GEARING.—J. L. WARD, 115 So. Walnut St., Hutchinson, Kan. The object of this invention is to provide a variable speed and reverse gearing which embodies the desirable features of both selective and planetary types and which is especially adapted for use with that class of motor vehicle requiring only two speeds forward and a reverse. Another object is to provide gearing in which the necessity for the use of brake bands, jackshaft, individual selectors is obviated.

SEAT.—D. C. GOFF, 1611 West Broad St., Richmond, Va. This invention especially relates to seats of the class designed for use with motor vehicles wherein the seat and the back are so connected that the seat does not move vertically relative to the back, during shock and jar, but wherein the parts are so connected and cushioned that resiliency will be provided, with the seat and back moving vertically together.

VALVE TAPPET.—F. H. BELLMORE, Brandon, Va. The invention relates more particularly to a valve tappet manufactured in two parts instead of one, and provides for the coaction between these parts in such way that an adjusting screw will engage respectively with the valve stem and the cam at all times. It is an object of the invention to provide for a more thorough lubrication of the tappet without danger of overlubrication and waste of oil.

RADIATOR SHUTTER.—L. S. HANSON, 419 Main St., Lewistown, Mont. The object of the invention is to provide a shutter for automobile radiators, including a series of vanes and horizontal strips, and means for conveniently operating the vanes associated with the dashboard of the car in such position that it is within manual control by means of a hand wheel. Any fine degree of adjustment may be conveniently secured by this arrangement.

WINDSHIELD CLEARER—B. VERLANGIERI, 315 E. 175th Street, Bronx, New York. The general object of the invention is to provide a device for clearing the windshield of snow or moisture, such device being mounted in position for convenient operation. A more specific object is to provide a device adapted to be readily taken apart or assembled.

TRANSMISSION BAND.—L. F. CRUMLEY, R. No. 3, La Follette, Tenn. The invention relates generally to transmission bands for automobiles, but particularly such automobiles as subject the band to a chattering or undesirable vibration and frequently become accidentally displaced. It is the object to provide a removable construction by which the undesirable features are eliminated while permitting of the ready removal of the band.

WINDSHIELD CLEANER.—S. ROBINSON, Box 245, White Plains, N. Y. An object of the invention is to provide an electrically operated device for wiping the moisture off the outside of a windshield, so that the operator of the car may be able to see clearly the road ahead when driving in snow, or inclement weather. A further object is to provide a wiper which will be simple, durable and inexpensive to manufacture.

WARNING SIGNAL.—J. D. COUGHLIN, 157 W. 123rd Street, New York, N. Y. An object of this invention is to provide an automobile signal having a diaphragm and a vibrator so formed and relatively arranged as to overcome the startling and disagreeable sounds produced by the usual signal, this object being attained by a contact element on the diaphragm which may be operated gently and with the minimum expenditure of force. The device is simple and compact, adapted to a wide field of usefulness.

SAFETY ANCHOR.—C. R. DOWER, Box 146, Fellows, Calif. This invention relates to anchoring devices for the radiator caps of automobiles, its object is to provide an anchoring device which is inexpensive, can be easily inserted into the tank or radiator, is strong and will resist the ordinary pull exerted on a cap when unscrewed by the rapid motion of the machine, and still may be easily removed from the tank when desired.

PLATFORM FOR TRUCKS.—A. T. GOLDFIELD, Spring Valley, N. Y. This invention relates more particularly to platforms or stands adapted for use in connection with elevating transporting trucks. The primary object is to provide a platform which will have greater rigidity than the platforms usually constructed, and to so construct the platform that in large sizes the truck will be automatically centered, thus preventing rocking of the platform relative to the truck.

SOLID TIRE.—C. V. HONECKER, Brookville, Ind. This invention has for its object to provide a solid tire so arranged on the wheel that movement of the tire with respect to the wheel will cushion the jolt and jar of the wheel, permitting the easily punctured and expensive pneumatic tire to be dispensed with.

AUTOMOBILE SIGNAL.—I. R. JOHNSON, 1059 3rd Ave., New York, N. Y. The invention relates to direction signals and particularly to a semaphore signal pivotally mounted to be swung to a position projecting from a side of the car. The general object is to provide a signal with spring means, that when projected, will yield to a blow in either direction to prevent breakage.

MUD GUARD FOR AUTOMOBILES.—F. P. FRANCIS, c/o Diamond Match Co. Orland, Calif. Among the objects is to provide a mud guard having means for protecting the front end of the automobile, which at the same time will force part of the air through the air space in the radiator, whereby the same is cooled more effectively, and will protect the lamps from mud or dust, prevent rattling, and in no way interfere with the oiling of the car.

Designs

DESIGN FOR A POWDER CONTAINER.—C. S. HUMPHREY, c/o Manhattan Chemical Co., Bush Terminal Bldg., No. 10, Brooklyn, N. Y.

DESIGN FOR A CHRISTMAS-TREE ORNAMENT.—G. H. NEIDLINGER, Bloomfield, N. J.

DESIGN FOR A RIBBON OR NARROW FABRIC.—D. C. FRANK, 395 Fourth Ave., New York, N. Y.

DESIGN FOR AN ELECTRICAL FIXTURE ARM.—M. H. DWORKIN, 271 Canal St., New York, N. Y.

DESIGN FOR LACE.—A. MEGIDOW, 327 11th St., West New York, N. J.

DESIGN FOR AN ELECTRICAL FIXTURE BOWL.—M. H. DWORKIN, 271 Canal St., New York, N. Y.

DESIGN FOR A BADGE.—T. W. HALL, address Mrs. J. A. Perdue, 195 Juniper St., Atlanta, Ga.

Book Reviews

THE THEORY OF MACHINES. By Robt. F. McKay, M.Sc. London: Edwin Arnold. New York: Longmans, Green and Co., 1920. 8vo.; 440 pp.; 407 diagrams.

Professor McKay deals systematically and embracingly with all parts of his subject. He anticipates the student's difficulties in his initial survey of underlying principles. The treatment of mass and force commits itself to the engineer's unit of mass for the sake of practical advantages. Reuleaux's notation of lower and higher pairing is used as a basis of classification in the kinematics of machines. Numerous exercises serve to link book-work to practice.

DER WERDEGANG DER MENSCHHEIT UND DIE ENTSTEHUNG DER KULTUR. By Hermann Klaatsch, M.D. Berlin: Deutsches Verlagshaus Bong and Co., 1920. 8vo.; 302 pp.; illustrated.

While the anthropologist will find nothing startlingly new in this work, he will encounter shrewd observation, logical deduction and a pictorial museum of human types particularly rich in Australian examples, many of them photographed by the author. From the cobwebbed bottle of the past he pours live wine that reflects intriguing lights upon our present.

THE CHEMISTS' YEAR BOOK. 1920. Edited by F. W. Atack, B.Sc., assisted by L. Whinyates, A.M.C.T. New York: Longmans, Green and Company, 1920. 16mo.; 2 volumes; 1136 pp.; illustrated.

This handbook of British origin, now in its fifth year, publishes a vast amount of information for chemists and scientific workers. It was designed to take the place of similar German works, and is full and accurate. Most of the data is arranged in tabular form, and among other newly-revised sections are those dealing with dairy products, carbohydrates, and physical chemistry constants.

THE BOSTON AND MAINE RAILROAD. By Francis B. C. Bradlee. Salem, Mass.: Essex Institute, 1921. 8vo.; 84 pp.; 26 illustrations.

Mellow plates on tinted paper bring old Boston vividly before us. The railroad stations, trains, and steamboats of bygone days, and the men who guided the destiny of the Boston and Maine, stand forth in picture and narrative. The text relates the story of the main road and its tributary lines, their history, achievements and finances.

AEROPLANE STRUCTURAL DESIGN. By T. H. Jones, B.Sc. and J. D. Frier, A.R.C.Sc. New York: Isaac Pitman and Sons, 1920. 8vo.; 267 pp.; 121 illustrations.

The Pitman impress assures designers, draughtsmen and students of the value of the authors' exposition. Methods of estimating the strength of airplanes under loading are the subject of careful examination; utility and simplicity are the aims; and leading British firms have contributed from their experience. Eight plates of superexcellence embellish the work, and there are numerous tables of strong appeal to those seeking up-to-date knowledge.

INSTINCT AND THE UNCONSCIOUS. By W. H. R. Rivers, M.D., D.Sc., F.R.S. New York: The Macmillan Company, 1920. 8vo.; 252 pp.

The system of psychotherapy adopted by Great Britain in the treatment of the psychoneuroses of war is here put into a biological setting. The author is closely observant and has an unusual faculty for arguing connectedly from the concrete to the speculative but probable. He exercises a laudable caution in defining instinct, the unconscious, and similar terms we often use too vaguely, and his interpretation of psychological theories and principles commands our respect and admiration.

THE ELECTRIC FURNACE. By Henri Moissan. Authorized translation by Victor Lenher, PhD., Easton, Pa.: The Chemical Publishing Company, 1920. 8vo.; 313 pp.; illustrated.

This translation deals with a subject of great industrial importance. The four chapters of the work take up the different forms of electric furnaces as applied to the fusion and volitization of refractory bodies; the preparation, by means of the electric furnace, of a number of elements, the three varieties of carbon; and researches on various compounds. It is needless to point the reader to Professor Moissan's status in the electro-chemical world, or his achievements in high-temperature research.

ADDITION TO STARRETT CATALOG

The Supplement to the Starrett Catalog No. 22 "B" will be particularly appreciated by those who wish to keep in touch with the newest designs in precision tools. Many of the improvements listed in this Supplement will be the direct means of saving time and money to those who work metals to close limits.

Mechanics who prefer a 1-inch movement in a Depth Gage will be interested in the *Starrett Micrometer Depth Gage No. 440*. Each Gage has three measuring rods with hardened and lapped ends and provides measurements of the depths of holes, projections, etc., from 0 to 3 inches by thousandths of an inch. Unless otherwise ordered, the 440 is sent with case.

To meet the desire for a better Micrometer Caliper case, the Starrett Co. has designed a metal case which is proving very popular everywhere. This case *(No. 910)* is made for the 1-inch Mike only. It is lined with black velvet and has round corners, is very compact and weighs but seven ounces.

The *Starrett Inspector's Micrometer Caliper Gage No. 175* was designed particularly for measuring the walls of cylindrical forms through a drilled hole in a flue or pipe where it would not be otherwise possible to secure accurate measurements. This gage is made to read by thousandths of an inch and its peculiar construction makes it possible to obtain as exact measurements on flat surfaces. *No. 175* is used by U. S. Government Inspectors for testing Boilers, Flues, Tubing, Drawn Die Work, etc.

The Dial Sheet Gage No. 170, easily held with one finger through the ring while the thumb presses the button above, determines quickly and accurately the thickness of paper, steel, fibre, cloth, leather, celluloid, etc. Its simplicity and ease of operation are making it a great favorite wherever used.

The *Combination Square No. 94* with Level, Miter, and Plumb makes a special appeal to those who do not require a fine graduation of the blade or a scriber. Blade is graduated 8ths and 16ths on both sides. Made only in 12-inch length. The selling price of this Combination Square ($1.50) makes it one of the most popular tools in the Supplement.

Many other tools are shown. Be sure to ask for *Supplement to Catalog No. 22 "B"*—it will be sent free on request by

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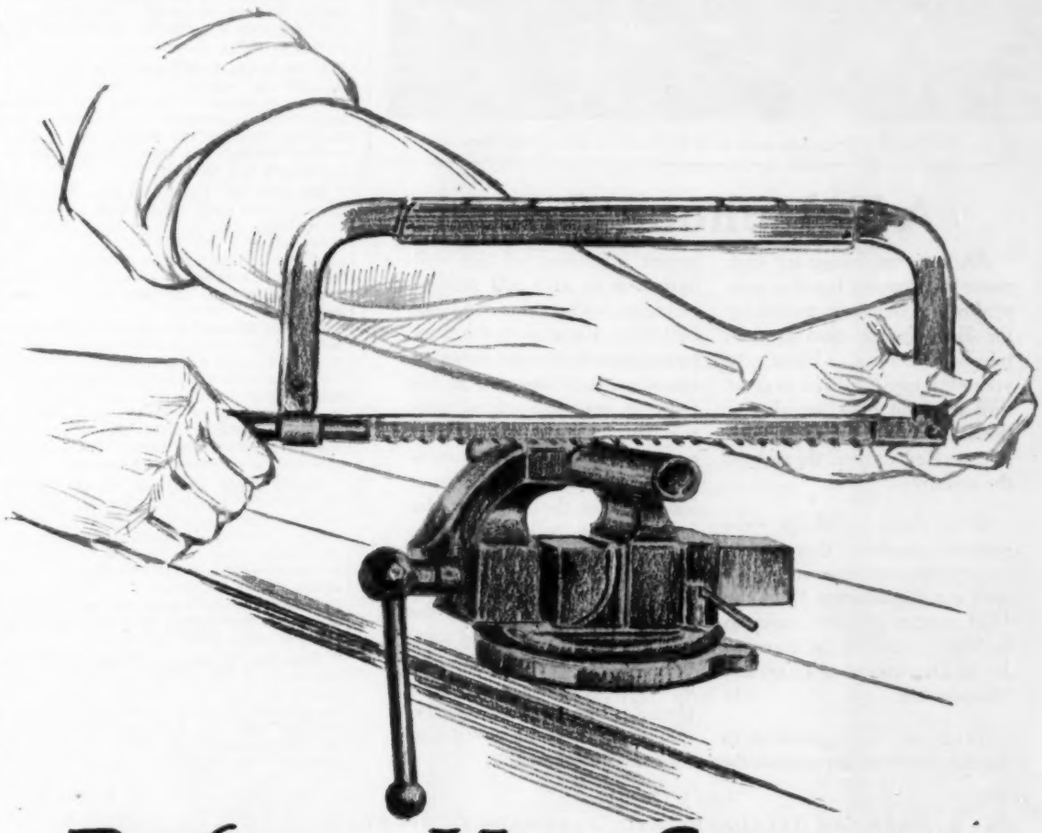

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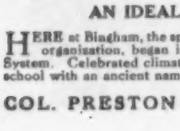
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Science Notes

A Digest of Everything of General Interest Appearing in Current Literature

Special Training for Foreign Service is now offered by 71 colleges and universities. The University of Washington leads with 407 students of this subject; New York University is second with 401.

Glass Models of Mines are prepared by first washing the glass with Bon Ami; the surface which is to take the lines is dulled with a pencil eraser, and drawing ink is applied by pen or brush. Oil paints, requiring a day or more for drying, are thus dispensed with.

A Pin in the Left Lung of a little Kansas girl was removed by the aid of one of the latest devices of science, the bronchoscope. The instrument was inserted in the bronchus through the mouth, and forceps, lowered through the tube, brought out the pin within two minutes.

Bringing the Dead to Life.—Many apparently dead persons have been resuscitated by injecting into the heart one cubic centimeter of a 1 in 1000 solution of either adrenalin or pituitrin; the injection is made into the left intercostal space one or two finger-breadths to the left of the sternal border.

Gorgas Memorial Institute.—The institute will be established at Panama for the study of tropical diseases, and will be closely associated with two hospitals and the Palo Saco Leper Asylum. It will constitute a tropical station for the Harvard School of Tropical Medicine, and Dr. Richard P. Strong, head of that school, will also serve as scientific director of the institute.

The Child's Reaction to the Movies was recently tested in Chicago, and some unexpected results were obtained. The 5000 children were blasé towards elephants; bison thundering over the prairie met with a heartier reception; but it remained for the skunk, above all other animals, to excite their enthusiasm. The picture of a boy stealing apples and wading in shallow creeks put many of the children to sleep.

Breeding Snakes for Bounty.—The Department of the Yonne, infested by vipers, offered 20 centimes a head as a bounty. Two enterprising farmers turned their land into a snake farm, and had sold 48,000 heads to the Government when their envious neighbors gave the game away. A sentence of two years "for obtaining money on false pretences" was reduced to 18 months, since it had to be admitted that the men had kept the letter of the agreement.

An Airways Weather Map.—The London-Continental airways officials are erecting a large map at the London Station that, for the benefit of pilots and the public, will show the weather, from hour to hour, at points along the routes. Wireless reports from France, Belgium and Holland are given. On the Lympne Field, in huge white letters, are the latest reports from London way, and pilots arriving from the Continent can thus see what weather will be encountered between the coast and London.

Fisherman's Luck.—Puget Sound and neighboring harbors have been invaded by mackerel, cod, halibut and other known and unknown species of fish. Thirty thousand pounds of plaice were taken in a single haul, and a 30-pound cod was caught from a wharf; near Bremerton Navy Yard seiners discovered huge quantities of a tiny fish resembling the Norway sardine. This inshore movement of fishes is laid to a great earthquake that disturbed the floor of the Pacific and caused an abrupt change in the currents of the Northwest coast.

German Alchemist Is Discredited.—Professor Fisher of Yale, who has been abroad investigating the reported production of synthetic gold by a German scientist, and who at first credited the story, is assured by a genuine German scientist that the gold-maker is a fraud with a prison record. Professor Fisher's investigations disclose the fact that the Government at one time made serious attempts to produce gold in new ways and did, in fact, succeed in extracting it from seawater, but not at a profit. These attempts have apparently been abandoned.

New Radium Deposits.—During the war an unknown Belgian traveler sold to a curio dealer a strange stone picked up in the Congo. The dealer sold it to the British Museum. Examination showed powerful radioactivity, and Belgian geologists were informed. An expedition was sent to the Belgian Congo, where two veins were discovered, one near the Portuguese frontier. The mineral is named "curite" after the discoverers of radium, and the deposits are said to be the richest in the world. Their radium may be isolated by simple dissolution in acid.

Deciphering Burned Records.—Records charred beyond recognition in a fire at Augusta, Ga., have been made legible by the Bureau of Standards. Chemical means failed, so Raymond Davis, chief of the photographic laboratory, laid the charred sheets between two photographic plates with the emulsion side next the paper. After two weeks of contact, the developed plates gave a plainly readable record. Where there was contact between the charred paper and the plate, the latter was affected, but where the ink had been the chemicals of the plate were unchanged.

A Boom in Leeches.—After many years of comparative neglect, the humble leech is again coming into its old popularity. But the old leech farms have long disappeared, and modern physicians who claim there are few better methods of relieving inflammatory areas than by the application of these blood-sucking creatures find difficulty in the supply. The "animated mustard plasters" are exported in baskets from Turkey, and Paris has one leech farm selling 130,000 a month, but it is said that chemists in England could easily dispose of double the number they are able to buy.

The Elusive Plesiosaurus.—The plesiosaurus hunters who have been attempting to track the Patagonian rumor to its lair are taking a holiday. Reports as to the why of this are conflicting. The newspaper men with the expedition say it is because the Governor of the territory of Chubut has issued an edict forbidding hunting, fishing or trapping for the monster. The Governor denies issuing any such edict. Meanwhile the hunters are enjoying themselves in the beautiful lake region known as the Argentine Switzerland while cabinet ministers fight the matter out.

Sea Lions Invade a Lighthouse.—The keeper of Bride's Island light, below Cape Flattery, has appealed to the Federal authorities in Tacoma for weapons and help. No sooner does he open his door than sea lions force their way into the house and make free with his possessions. At night they surround the place, barking for admittance, until sleep is impossible. One big fellow amuses himself by climbing the exterior steps to the light, to plunge headlong into the sea. To kill one would only attract more, for the smell of putrefying meat is an irresistible attraction.

Eruption Follows Earthquake.—Last March two mild earthquake shocks were succeeded by the collapse of the 200-foot eruptive cone of Vesuvius, inside the crater, accompanied by rumblings, explosions, and the ejection of ashes and white-hot stones; in 24 hours the liquid lava covered an area of 100,000 square feet; around the crater it formed a molten band with a temperature of 2000 degrees Fahrenheit. Professor Malladra, director of the Vesuvius observatory, descended into the crater at the start of the eruption, and escaped with a badly-scorched face. The width of the crater is now 1500 feet.

Food from the Skies.—Washington has received from Bagdad samples of Turkish manna. This manna falls like dew during the autumn months, lodging on the leaves of oak trees and hardening into the form of grain. It is supposedly the same substance used by the children of Israel in the wilderness, and is a recognized article of commerce in Syria; sheets are spread under the trees in the early morning, and the trees are shaken. Only the oak tree retains the substance until it hardens; such of it as falls elsewhere is lost. It is a good substitute for sugar and honey, and sells for 45 cents a pound.

Civil Engineering Notes

Abstracts of Important Recent Papers and Published Articles

Concrete May Be Poured Under Water by standing a pipe in the desired position. The concrete, poured through the pipe, will remain intact on its removal, and will set satisfactorily.

The Strain on Country Roads.—A report of the Department of Agriculture shows the tonnage of 11 crops hauled to market over country roads. In five years the average per year was 27 tons hauled for every 100 acres of land, or 86,560,000 tons.

A Subterranean River.—The mysterious difficulties which Lubeck, Germany, has been experiencing with its water supply are found to be due to an unsuspected underground river, with several tributaries, emptying into the Baltic about 20 miles beyond the seashore.

Wiping Out a Mountain.—The mountain Morro de Castello encroaches on the business section of Rio Janeiro. It has been decided that this huge excrescence must go. Twelve million dollars, raised in the United States, and twelve men, also raised in the United States, will endeavor to impress upon the mountain the fact that it is *persona non grata*. The hint will be conveyed by means of dynamite, hydraulic pressure, and pick and shovel.

Harbor Oil Hazards.—Oil pollution, Secretary Hoover testified before the House Rivers and Harbors Committee, destroys fish, is a menacing fire hazard, and is seriously damaging the beaches. Our industrial communities eventually pay the bill. New York harbor is beyond redemption so far as fish are concerned. Murray Hulburt, Dock Commissioner, said that oil in the waters of New York harbor might any day result in a fire that would wipe out the wooden piers and structures along the waterfront. Immediate action in the matter was urged.

Open Pier Deck to Resist Storms.—A recent issue of *Engineering News-Record* gives data and illustrations of an interesting harbor installation at an exposed point in Manila Bay. The pier carries a double-track railway and must stand up under extraordinary pounding when the typhoon blows. The result has been achieved by building the pier in the form of an open crib between the two tracks, which are placed considerably further apart than normally with this end in view. The fact that the wharf is designed to carry only live trains, and not as a storage place for deck-loads, makes this expedient possible.

Smallest Railroad in the World.—During the war the Governors Island, Fort Jay, Castle Williams and Filled Ground Railway, with its one engine, two flat cars, a gondola and a box car, and its 29,000 feet of track, was a very busy road. The termination of hostilities killed its usefulness, and now 28,600 feet of its track, 24 warehouses, half a mile of shedding and 5,800 heads of automatic sprinkler system are offered for sale, while the lone sergeant who ran the road has gone back to soldiering. What little is left of it after the sale will be scarcely longer than its name, and its title to the claim of being the smallest railroad in the world will be even more unassailable than before.

A Survey of Our Roads.—The general condition of our highways will be disclosed by a survey of the mileage, cost, and character of construction, to be made by the Bureau of Public Roads. This is the first survey of the kind in 7 years, and the most extensive ever undertaken. Not until the work is completed may we even guess how many miles we have, the strength and weakness of these arteries of transportation, or what assets they represent. Comparisons of costs and maintenance will then be available to our road builders and the information, once obtained, will be kept up to date. As future legislation may be based on percentage of road mileage, road officials, organizations and individuals are asked to cooperate with the Government in this gigantic task.

Deterioration of Concrete Bridges at Nashville, Tenn., the city engineer reports, was caused when limestone screenings were used for the very fine aggregate in the concrete instead of sand. This limestone was the product of a quarry interspersed with seams of shale. The limestone ledges were of a superior quality of rock, but apparently no special precaution had been taken to exclude the shale. As a consequence, he is satisfied that the limestone screenings used in the mixing of the concrete of this structure were heavily charged with argillaceous impurities, and that this admixture of shale was certainly one of the causes of disintegration in the concrete.

Alaskan Mineral Resources, according to a recent Geological Survey report, include good prospects for silver and lead mining on a commercial basis in the Kantishna Valley. About 50 prospectors are at work, and a good deal of placer mining is being carried out. Two companies have been organized for hydraulic mining, but will not begin work for some months. Transportation in this district is poor; if it could be brought up to the mark there is little doubt that it would be followed by mining operations on a large scale. In addition to the large undeveloped resources in gold, there are to be considered the resources of the country in tin, platinum, tungsten, sulfur, antimony, mercury, graphite, gypsum, etc.

Tar Pollution of Fishing Waters.—The publication is shortly expected of an interim report prepared by a joint departmental committee of the Ministries of Transport and Agriculture upon the question of damage caused to fisheries by tar pollution from road rain washings. As a result of experiments at Arlesford, Hampshire, the committee has found that the maximum toxic effect upon fish of the rain washings from a tar-treated road occur at two distinct periods, namely, when the road has been recently tarred, and when its surface is disintegrating. It is suggested that highway authorities should give preference to an asphaltic bitumen free from tar products for treating roads draining directly into fishing waters.—*The Engineer.*

Elastic Properties of Small Wire Cable.—In aircraft manufacture several sizes of small wire cable are used, and for effective design a knowledge of physical characteristics of such cable is important. In a paper presented before the A. S. M. E. in December, R. R. Moore gives the results of tests carried off at Dayton. It is shown that the modulus of elasticity of small wire cable varies between 15,000,000 and 28,000,000. Between specimens identical in specifications and apparently in make-up there may be a difference as high as 3,000,000. Loads upon the cable, below the elastic limit, have the effect of raising the modulus of elasticity; but resting the cable seems to have no effect either way.

Coal in 1920.—Bituminous coal production was normal during the first quarter, except for the decline due to February storms; then the outlaw switchmen struck, demoralizing transportation, and the withdrawal of Government maximum prices and the great export demand combined to shoot prices up to record levels. By December business stagnation was influencing output, until in April of 1921 production was but half the capacity of the mines. Anthracite started the year well; then came labor troubles, and 1920 terminated with production but a million short tons over 1919. The plans of the Federal Power Commission and the Superpower Survey should lead to increased use of hydroelectric power and this, with better transportation and more economic use of coal, may slow down the rate of depletion.

Wasting Coal By-Products.—By burning raw bituminous coal instead of coking it we are annually wasting fertilizers of a crop-producing value of 800,000,000 bushels of wheat. Such is the import of figures presented to the Senate Finance Committee. Based on the annual production of 585,883,000 tons, the annual loss of ammonium sulfate by present methods is $354,037,560, or enough to fertilize 118,000,000 acres. Experts estimate that 100 pounds of ammonium sulfate to the acre will increase the yield by 7 bushels. The ammonium sulfate wasted by bee-hive ovens alone would mean an increase of wheat production by 60,000,000 bushels a year. Nor is agriculture the only industry affected by this waste of coal-tar products. The manufacture of paper, glass, glue, leather, paint, rubber goods and many other commodities depends upon the use of chemicals that are coal-tar derivatives.

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Mechanical Engineering Notes

Survey of Progress in the Mechanical Arts Gathered from Various Sources

Deformation Temperatures of Brickwork formed the subject of an illuminating discussion by E. B. Ricketts. Methods of preventing this serious difficulty by currents of steam or air, and by circulating water through the brickwork, were outlined.

The Use of Diamond Tools in the machining of fiber, hard rubber, and similar substances often affords a means of escaping the heavy costs of frequent resharpening and resetting of the ordinary type of steel tools. Nor is the cost of the diamond points and edges as serious as it might appear it would be.

Air Heaters with Low-Grade Fuels were discussed both pro and con at the Fuel Waste Session in December. On general principles argument seems to be in their favor: but it is pointed out that on account of sulfur content of the fuel, they might in certain instances be accompanied by conclusive disadvantages.

Efficiency Ratings are subject to considerable confusion and ambiguity because of the difficulty of separating the efficiency of the boiler alone from that of the combined boiler-furnace unit. Notwithstanding the difficulty of effecting this separation, it is well worth while to attempt it, and methods are available for doing this.

The Uniform Tightening of Bolts, which is of some consequence in many instances, and which sometimes actually conditions the successful operation of a machine, is extremely difficult with ordinary manual operation of the standard wrench. Wrenches with friction-release gears have been put on the market, the release coming into action as soon as the tension reaches a predetermined figure.

Pressed Steel Machine Handles are a desirable improvement over older fashions. They are neat, light, and uniform in shape. They possess a strength that is fully up to any operating strain. Hollow and seamless, they are made in a range of sizes to meet every hand-wheel and lever need. There does not seem to be any reason why they cannot also be used for screw-drivers, chisels and other hand tools.

The Inventor of the Machine-Gun.—Lyons, France, puts forward this claim in behalf of Du Perron, who offered Louis XVI., in 1775, a military "orgue" capable of firing 40 bullets almost simultaneously. The king rejected it as too murderous and the inventor was called an enemy to humanity. Hostile powers endeavored to secure the gun, but Du Perron was too patriotic to meet their advances. He died in poverty.

A New British Galvanizing Process has been put out, not intended to replace the ordinary procedure of hot galvanizing with virgin spelter, but aimed at the large variety of uses where this is too crude. Frequently an extra smooth surface is required; or the temper of the coated steel is to be retained; or the piece is part of a big-production article in which distortion must be avoided; or bolt-threads, etc., are to be coated but not to be retapped; and so on. The rough and ready method that is entirely adequate for ordinary wire and sheet metal is here quite out of the question, and it is in such places as this that the new "electro" method is recommended.

A Phenomenon of Grinding.—Probably everybody with extensive experience in grinding has noted that surface grinding of metals tends to curl the work toward the side on which the wheel is working, and that the thinner the stock the more pronounced this tendency. E. A. Dixie, in *American Machinist* for December 22nd, discusses this matter and puts forward a suggested explanation which is at least plausible. He points out that the work is heated above the critical point by the heater, and cooled by the fluid with sufficient suddenness to justify the assumption that quenching takes place. He suggests that this may shorten the linear dimensions of the side affected, and points out that some action of comparable character with that which he outlines must be involved, since the steel must be distorted with a force exceeding the elastic limit in order to effect a permanent set of the reverse side.

Steam and Air Flow.—That steam when expanded rapidly as in turbine nozzles, becomes supersaturated provided the initial superheat is not so high that it remains superheated throughout the expansion, is now recognized. Whether any condensation occurs before the nozzle throat is reached is not so definitely known; but evidence here is afforded by a series of experiments indicating that the coefficient of discharge for saturated steam is slightly less than that for air and for superheated steam, which are about the same. It would appear from this that there is little or no condensation in the expansion of saturated steam in a nozzle down to the critical pressure ratio.

A Jack Operated by Compressed Air, for use in factories and garages, is described in a recent issue of *Automotive Engineering*. A six-inch model has a piston-head area of 28¼ square inches, and with an air pressure of 100 pounds will lift 2825 pounds. An 8-inch model with piston-head area of 50¼ inches will lift, under the same head of air, 5250 pounds. By attaching a standard air-gage with special dial graduations to the cylinder of the jack the latter may be used as a weighing device, indicating directly the weight on the tires. The particular jacking advantage claimed is rapidity of operation, five seconds being considered ample time to get a car clear of the floor.

A Rotary-Valve Internal-Combustion Engine which appears to be rather more promising than most of the inventions in this category was shown at the Automobile Exposition in New York. The valve consists in a general way of a long hollow cylinder with appropriately arranged ports, etc., which sets in the cylinder head, running the entire length of the engine-block, and rotates at one-sixth crank-shaft speed. Depressions and runways in the surface of the inner and of the outer shell match up in such a way that intake and exhaust channels are opened to each cylinder of the engine at the right instant. So far as the "valve" itself is concerned, there is but the one port, which serves alternately the various functions necessary.

Hardening Polished Tool Steel.—Articles of polished tool steel may be hardened without raising a scale and destroying the polish by the following method: Prepare equal parts in bulk of common salt and fine cornmeal, and mix well. Dip the article to be hardened first into water, then into the mixture; and place it carefully in the fire. When hot enough to melt the mixture, remove from the fire and dip or roll in the salt-meal mixture, after which replace it in the fire and bring to the heat required for hardening. Watch the piece closely and if any parts show signs of getting dry, sprinkle with the mixture. The latter, when exposed to heat, forms a flux over the surface of the steel which excludes the air and prevents oxidation, yet when cooled in water or oil comes off easily, leaving the surface as smooth as before heating. Borax would possibly give the same result, concludes the *American Blacksmith*, from which we quote, but is sometimes difficult to remove when cold.

New Etching Mediums for Steel are described by Dr. A. Fry in *Stahl und Eisen;* and particularly a new etching method consisting essentially of a strong acid solution of copper chloride over a properly prepared steel. The new medium reveals in details the strain lines in a low-carbon steel as distinct from the actual crystalline pearlitic or other structure. In other words, it permits locating alterations in the body of steel caused by stress. In this connection mention is made of an experiment recently conducted by a large eastern railroad, the results of which are in good accord with those obtained by the German method. Thin strips of highly polished low-carbon steel were laid on the surface of the rail, over which the locomotive wheel was allowed to press gently. It was found that there resulted in the strips a distinct set of lines entirely different from anything encountered previously. It is now found that these lines bear a close resemblance to the strain lines brought out in one of the pieces of German steel.

Electrical Notes

Summaries and Excerpts from Current Periodicals

New Miracles of Science.—At the Bell System laboratories, members of the American Institute of Electrical Engineers were entertained with demonstrations of marvelous new devices. Using an ordinary telephone transmitter, a speaker saw his "words" projected on a screen in electric waves of distinctive forms; 10,000-watt vacuum tubes, with untold possibilities in wireless and power fields, were shown; singing, talking and "shimmying" crystals of Rochelle salts were put through their paces; and by another device molecules were heard to turn over when polarization was changed.

Electric Shovels in City Work.—In contracting work in cities there is no smoke, no sparks, no objectional noises attendant upon the operation of the electric shovel, as compared with the steam shovel. In addition, the electrically-operated shovel gains time over the steam-operated shovel, due to the elimination of delays encountered with steam equipment. These delays are those incident to supplying the boiler with fuel, clearing trouble on the water line, and the more protracted shutdowns required for repairs. It is surprising that the electric shovel is not being used to a greater extent.

From Iron Wire to Copper Wire.—Owing to the high cost of copper wire during the war, iron was largely used as a substitute. The precise electrical properties of iron and steel can only be vaguely known, as they vary with the sample, though chemical analysis may show no difference between the samples, according to *Electrical World*. However, it is found in practice that the losses with iron and steel conductors are very heavy, and it is believed that there are numerous cases in which it would be an advantage to revert to copper. It is said that the losses per mile increase very rapidly after the first few miles.

Luminous Spots for Electric Devices.—In order to enable the electrical manufacturer to put out an illuminated device without in any way engaging in the luminous material technique, a leading manufacturer of luminous material has developed standardized luminous units which can be molded into composition or mechanically inserted directly into metal. This idea lends itself to adoption in many ways, according to *Electrical Record*. The same disk which goes in the switch-push button can be used for many other purposes. Naturally, the size can be varied, and it is possible to use celluloid, mica, a plain glass lens, or faceted glass lens for the front.

Wired and to Be Wired Houses.—Every so often everyone in the electrical field gets the pessimistic idea that the market has about reached the point of saturation—that all that must be done in electrical wiring and other work has been done, and little remains but to wait for new houses to be constructed. Such is not the case, however, as statistics soon indicate when studied. Only 36 per cent of the homes in America are electrically wired, and the remaining 13,508,000 homes are yet to be wired. Imagine the amount of labor, the materials, the central power equipment, and the capital required to "electrify" the greatly handicapped houses! And then there are many new houses, hotels, garages, theaters, schools, and so on being erected at the present moment, all requiring electric wiring.

Electrical Farming Machinery.—An electric windlass for plow operation is described in a recent issue of *Revue Generale de l'Electricite*. This windlass has a specially designed guide roll for the pulling cable, a hydro-pneumatic shock absorber to guard against suddenly arising overloads due to irregularities in the soil, an overload clutch between the drum and the 35-horsepower motor, and so on. If the windlass car is properly anchored, a pull of 7000 to 8000 pounds may be exerted upon the plow cable. To minimize the cost of temporary electric power lines the use of extremely heavily-creosoted wooden poles so strongly penetrated with creosote as to be called "poteaux noirs" (black poles) is suggested. Wooden poles so treated have such a high electric resistance that it is possible to nail bare wires directly to them, resulting in a negligible loss at voltages up to 550.

Motor-Driven Screw Driver.—Removing or putting in small screws by hand, when taking down or assembling electrical and other devices, is a slow process, states *Electrical Review and Industrial Engineer*. A large Eastern repair shop, therefore, makes extensive use of a device driven by an electric motor, for this kind of work. The electrical screw driver consists of a sewing-machine motor mounted on an iron base, which in turn is fastened by a U-shaped member to the table. The pulley end of the armature shaft of the motor is fitted with a knurled sleeve provided at each end with a flush set-screw, one for fastening the sleeve to the shaft and the other for holding the screw driver in the sleeve. Instead of a screw driver, a socket wrench can be mounted in the same way and used for putting on or removing small nuts. With the aid of this device an operator can do at least four times the amount of work that could be done by hand.

Heat and Commercial Insulating Materials.—The variation in electric strength of many of the solid insulating materials at present employed in the manufacture of electrical machinery and apparatus was investigated between the temperatures of 30 degrees Centigrade and 100 degrees Centigrade, and reported upon before a recent meeting of the Institution of Electrical Engineers of Great Britain. The materials used were various kinds of prepared paper, micarta, fuller board, varnished cloth, mica, and some miscellaneous materials. These tests showed that in the case of some of the materials used at present the breakdown voltage at 100 degrees Centigrade may be only one-half that at 30 degrees Centigrade. Consequently, all insulating materials should be judged and used in accordance with the breakdown voltage at 100 degrees Centigrade, and not on the results of tests carried out at air temperature.

Spanning Messina Strait.—The transport of energy from the hydro-electric plants of Calabria to Sicily, which is now being studied in Italy, will require the crossing of the Messina Strait. The narrowest part of the strait is 3200 meters across, but taking account of the space for the poles the distance would be 3450 meters. The cables for this mighty span would be six galvanized steel ropes about three-quarters inch in diameter, spaced 340 feet apart. The same problem has been studied from the standpoint of a submarine power cable, but it is reported that in the narrowest part of the strait the currents are so violent that no armored cable can stand for long, so a point some distance to the south of the narrowest part has been selected for study. Two types of cables would be necessary, one for the deep-sea portion and the other for the coasts. The coast cable would be insulated with India rubber and protected with lead and 24 steel wires. The deep-sea type would be insulated with rubber and wound with brass ribbon in order to prevent attack from teredos. The voltage transmitted would be 25,000.

Railroad Electrification.—One advantage of the electric locomotive that is frequently overlooked in comparisons with the steam locomotive is the fact that the former is more "fool-proof," states *The Practical Engineer*. The electric locomotive is provided with meters affording complete knowledge and control of operating conditions, also forming a valuable guide to the handling of a train, particularly in starting. The economy of electric traction is not dependent upon man, as is the case with steam, and operation is therefore no longer a matter of individual human judgment, skill, or fidelity. The theoretical advantages of the steam locomotive are more often than not in practice nullified by the human element. Brick arches, superheaters, stokers, siphons, automatic fire-doors and power reverses all show low average results because their properties for increasing efficiency are dependent upon the intelligence and faithfulness of the engineer, who is only human. In the modern power house, on the other hand, the efficiency devices are used in far greater completeness, and, in addition, there are trained men and carefully kept records to make sure that they are properly used.

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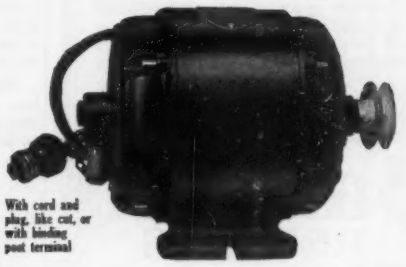

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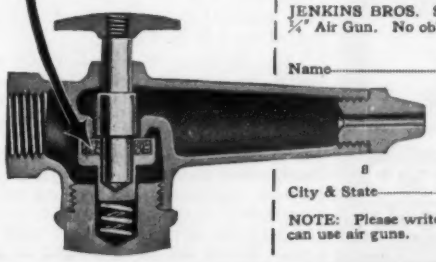

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Miscellaneous Notes

Odd and Interesting Items from All Sorts of Sources

Sugar-Beet Seed.—Much of the sugar-beet seed imported into the United States comes from Germany, and is received through the port of Galveston.

Microscopic Writing.—A Frenchman has written on an ordinary postcard 23,154 words—125,000 letters. The writing is said to be legible to the naked eye.

A Will Written in Shorthand has been admitted to probate in England. The testator, before dying in hospital at Antwerp, wrote the will in the form of a letter to his brother.

Finger-Printing a Town.—The town of Glenview has 2500 inhabitants and a bank. The cashier of the bank was shot and killed by a burglar, and the authorities persuaded the entire adult male population to register their finger-prints in an attempt to discover the criminal.

Funerals by Train for Paris.—Parisian cemeteries are so overcrowded as to threaten public health; cremation has proved unpopular. The municipal commission studying the problem advises the building of four big cemeteries 15 miles out of Paris, with railroad service to and from the city.

A Verdict on Violins.—"Old things are best" has always been accepted as true of wine and fiddles. But at the Paris Conservatoire, where six old and six new violins were played in complete darkness, the votes of the audience placed two modern violins first, then a Stradivarius, and after that a Guadagnini.

Finger-Printing a Corpse.—The body of Mrs. Elizabeth Maier, who was murdered in Westbury, L. I., was disinterred to be finger-printed. Her finger prints were compared with those found on a cream pitcher and sugar bowl, and found to be entirely different. Those on the china are said to agree with the finger prints of an itinerant peddler charged with the crime.

Colonel E. L. Mills, who saved the country thousands, possibly millions, by his new method of embedding small picks of silk in bank notes, died on January 17th, at Elizabeth City, N. C., at the age of 70. His idea was such a distinct improvement on existing crude methods of protecting the greenbacks that counterfeiting fell off 90 per cent after the adoption of the process.

Wire Netting for Packing.—The Federation of British Industries suggests that in order to prevent pilfering in transport goods should be packed in wire netting, the parcels being made into bales, with hoop-iron bands on the outside. The extra cost and weight would not be prohibitive, and since the package would have to be entirely opened up before its contents were accessible, the delay and difficulty would put a stop to much of the pilfering.

Refurnishing the Capitol.—Painters and upholsterers were busy in the Capitol last year. The ceiling lighting of the House was increased by 2000 square feet and the ventilation doubled. A new high-pressure water system provides fire protection, with its 62 valve outlets. Twelve thousand square feet of floors were surfaced, and 14,000 square feet of new marble tiling laid. New sculptures increase the statuary to 118 pieces.

Liquor and Votes in Old Pompeii.—The saloon was known in ancient Pompeii, as recent excavations disclose. A bar has been found, with a furnace and caldron for making the brew; there was even a little liquor left in the caldron. Election appeals were found on the walls; Lollius, a duumvir who looked after streets and sacred buildings, asks the votes of the frequenters of the saloon. This method of seeking votes antedates 200 B. C.

Disappearing Money.—In an effort to avert the small-change crisis France issued bronze-aluminum "jetons," or one-franc and two-franc tokens. These are disappearing at the rate of 800,000 a day—almost as fast as the mint turns them out. According to authorities these tokens, though intrinsically almost valueless, are going into the "woolen stockings" of the notoriously thrifty French to join the silver coins that vanished long ago. Means are being sought to force the people to disgorge the jetons.

The Beisan Heiroglyphics.—The University of Pennsylvania's expedition to the Holy Land has unearthed at Beisan, the Beth-Shan of the Scriptures, a large stone stela on which are 30 parallel lines of hieroglyphics, the first Egyptian inscriptions ever found in Palestine. These may establish a connection, hitherto unknown, between Egypt and Palestine, and antiquarians are awaiting a translation with great interest.

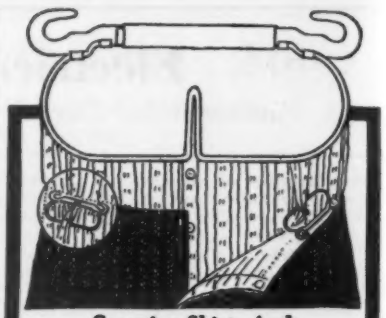
The Census in 3800 B. C.—While priding ourselves upon our census system it may be well to remember that census-taking is no new thing. The first count of British heads took place in 1801, after long opposition based on superstition. The Romans looked upon it as a regular institution. But it is now found that Babylonia took a census before 3800 B. C., which was perfected, and returns made by districts, in 2300 B. C. Fragments of the returns during the second dynasty of Ur are on tablets in the British Museum.

Squirrels and Gunstocks.—Black walnut is a fine ornamental tree of fairly rapid growth. The Forest Service points out that the merry squirrel was really the agent that supplied our Army with gunstocks; his habit of burying the nuts in open areas, where the saplings sprouting from them can secure the necessary sun, was "a big deposit to man's account in Nature's savings bank." There are about 821,000,000 feet of black walnut in the country, 50 per cent of it available for commerce. It requires good agricultural soil, and if the supply is to be adequate there must be careful management of existing groves and the immediate establishment of new ones.

What Our National Parks Offer.—Not the least of the claims made for the national parks is that they make for better citizenship by providing healthful diversion combined with unequaled educational advantages. Their use in 1921 exceeded all records; they were visited by 1,171,797 persons, as compared with 356,097 visitors in 1916. The world war, that closed European ports to pleasure travel, is to be credited with their unprecedented leap to popularity. Elaborate camping accommodations attract motorists, and hiking is now encouraged by furnishing definite itineraries. State parks are advocated, to be located every hundred miles or so along the main highways; this movement was auspiciously begun last year at Des Moines.

A Discovery in Watch-Making.—The great obstacle to precision in the time-keeping qualities of the watch has been the expansion and contraction of its parts caused by variations in temperature. C. E. Guillaume, Director of the International Bureau of Weights and Measures, has discovered an alloy that, used in the compensating parts, obviates this "secondary error." The minimum expansion of nickeled steel is found to be increased by the addition of 12 per cent of chrome, as well as by a very small quantity of tungsten, manganese or carbon. The new Swiss process mounts a spiral of the steel-nickel-chrome alloy in the watch. According to M. Guillaume, this perfectly accomplishes its purpose, and by simplifying the process of regulation should give a revolutionary impetus to the watch-making industry.

Every Man His Own Compiler.—Whatever business or profession a man may live by, his working library runs to numerous volumes; much time is lost in finding a needed item among thousands that are never used, while to the traveling man any such library is inaccessible. "Lefax," an ingenious loose-leaf pocket encyclopedia, solves the problem by enabling him to carry an amazing amount of self-selected, practical information right in his pocket. The leaves consist of blank and ruled forms—double, triple, and quadruple-folded, if necessary—classified as business, engineering, and cross-section (graph) paper; and of special sets of data sheets specifically covering various classes of knowledge; these data sheets provide self-indexing, nutshelled information. Clippings may be placed in linen-lined envelopes that fit the pocket binder, and filing boxes complete the system that men in all walks of life are adopting to great personal advantage.



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The Naturalist's Corner

Notes on Flora and Fauna from All Parts of the World

No Demand for Whale Oil.—Only eight ships are in the Norwegian whaling industry this year, as compared with thirty-three in 1920. Much unsold oil is in storage.

Bison Population.—There are now but 9311 pure-blooded bison in the world, and 3527 of these are in the United States, of which only 100 are running wild. Canada has 4916 captive and 800 wild bison. In 1920 1700 calves were born, reports the American Bison Society.

The Plague of Rats in England.—The rats of England have entered the profiteering class, and are costing the nation at least $350,000,000 a year. The problem is being discussed in London. Rat inspectors are suggested but, as one official remarked, unless these are Pied Pipers, little relief is to be expected.

Don't Kill Bullsnakes.—Kansas farmers find that a bullsnake in an alfalfa field is worth at least $2.50 a month; for an acre harbors, on an average, six gophers, which damage the crop to that extent. One adult bullsnake keeps an acre free of the pests. The bullsnake is harmless, feeds also on rats and mice around barn or granary, and deserves the protection of the farmer.

Denizens of the Deep Sea.—According to a statement by the world-famed explorer of the ocean's depths, the Prince of Monaco, deep-sea fishes, contrary to popular belief, do not explode when brought to the surface. Although constituted to withstand great pressures, they are, in fact, not only able to approach the surface without danger to their tissues, but actually do so at night to prey upon other animals.

Growth of the Fur Industry.—In the production and use of furs the United States leads the world. Sales for 1920 were about $100,000,000; in 1919 New York City alone did a gross business in domestic furs, counting import, export and handling, of $375,000,000. While demand has depleted our supply of fur-bearing animals, "fur-farming" is increasing, with the rearing of silver-black foxes as its most important branch.

Where Birds Spend Their Winters.—The Biological Survey finds that many of the birds migrating between the United States and Canada spend their winters in South America. Among these are the barn swallow, the golden plover, and the pectoral sandpiper. Some travel as far south as the Straits of Magellan. Federal protection of migratory birds has resulted in a marked increase of game birds.

Softwood Reforestration.—Dean J. W. Toumey, at an important meeting representative of all southern States interested in forestry, spoke of the acute situation due to a world shortage of coniferous wood, and the need for increasing production. Softwood is more important to civilization than hardwood, and must be grown on a vast scale. We are producing but a fourth of our needs, and that of inferior quality.

Life History of the Eel.—Most children have been told that a horsehair placed in water will develop into an eel, and some carry this belief into their mature years. However, Dr. Schmidt, a Danish scientist, finds that the eel lives up to eight years in fresh waters; adult eels go down to tidewater, where they spawn and die. Newly-hatched eels spend their early existence 500 fathoms below the surface, emerging from these cold depths in late winter.

Hunting Season of 1921.—At the opening of the season United States game wardens the country over were enthusiastic about the promising outlook. Game was more plentiful; in some localities ducks and geese were abnormally abundant; east of the Mississippi migratory birds were making their southern flight in unprecedented numbers; the quail (bobwhite) was seen in numbers not equaled for years; and even the deer was less scarce than for a long time back.

The Wild Animal Market.—Abroad there is great demand for wild animals and birds to remedy the depletion caused by the war. The New York Zoological Park has not only refilled it own cages but has shipped animals to Europe and even to Africa. Germany, that had almost coralled the business of supplying zoological gardens and circuses, is now practically out of this trade. Japan, says Dr. Hornaday, has opened 14 zoos in two years, and prices are soaring in response to the demand.

A Woman's Exploits in Africa.—Mrs. Frederick Dalziel of New York has some remarkable exploits to her credit in German East Africa. She is the first white woman to visit the noted extinct volcano in the Ngoro Ngoro country, with a crater 10 miles in diameter; she bagged many large animals, including an elephant, two rhinoceroses and seven lions, and is presenting a fine rhinoceros to the Museum of Natural History as a souvenir of her narrow escape from death when the beast charged her.

Our Boneyard in the Pacific.—The little island of Laysan, northwest of Hawaii, used to be white with the eggs of sea fowl when, in 1909, Japanese poachers slaughtered 300,000 of the birds for their feathers before Uncle Sam's cutter ran to the rescue. Today, where albatross, sooty tern, boobies, petrel and goonies used to flock, there is simply a huge boneyard—probably 40,000 tons of stuff available for lime and fertilizer. A Seattle man has secured the right to gather guano and bones there, and is outfitting three vessels for the trade.

How Far Flies Travel.—Experiments conducted by the Bureau of Entomology demonstrate that the house fly frequently journeys five or six miles in 24 hours, which emphasizes the sanitary importance of destroying breeding places. Some 234,000 flies of various species were dusted with finely-powdered red chalk and released. Baited fly traps were placed at measured intervals in all directions; thus the flights of different species were determined. The maximum distance traveled by the house fly was 13.14 miles.

Duck Hunting with Motor Boats.—To correct erroneous reports that have been circulated, the Biological Survey states that no changes have been made in the Federal regulations prohibiting the use of power boats in taking wild fowl; still grosser is that violation of the law known as "bushwhacking"; that is, the running down with motor boats of ducks that have settled among previously placed decoys. Power boats may be used to go to and from the ducking grounds, and dead ducks picked up from them, but ducks may not be shot from such boats.

Squirrels in Vancouver.—Twenty years ago 11 gray squirrels were taken from Kentucky and liberated in a park in Vancouver, Wash. Since then a thriving industry has been developed in filberts and English walnuts; and the squirrels, now numbering thousands, have also developed an astonishing industry with nuts as its basis. Instead of burying the nuts in quantities, where the growers might recover them, they bury each nut separately. As this army is at work for long hours each day, the growers are in despair, and deportation of the aliens is suggested.

The Origin of Corn.—Botanists have long held that our maize is descended from a wild grass called teosinte. Luther Burbank has experimented in this direction for 18 years, and has succeeded in producing, through successive stages of development, perfect ears of corn from teosinte. In the original evolution, aided by the crude agriculture of the Indians, it doubtless took centuries to become the maize that is now our most important crop. Incidentally, Burbank has created a most productive fodder crop that can be grown a thousand miles farther north and south than its present range.

A Pigeon's Long Flight.—An exhausted pigeon picked up at Columbus Circle was found to bear a message from Edmund Heller, the well-known naturalist now making a survey of the animals of Yellowstone Park. The message, upon being read, declared that the writer was lost on the Hoodoo Mountains, and asked that help be sent. It was addressed to his fellow-naturalist, Dan Singer, who identified the pigeon as one of a flock they had trained together, and promptly wired orders for a rescue party. As it is 1,900 miles from Yellowstone Park to New York, and the bird apparently made this in five days, it had to average 380 miles a day.

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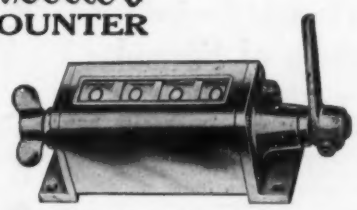
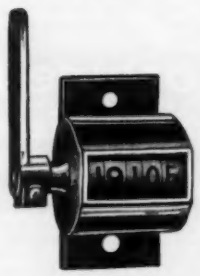
Veeder COUNTER

The large Set-Back Revolution Counter at right is less than ½ actual size. The small Revolution Counter below is shown nearly full size.





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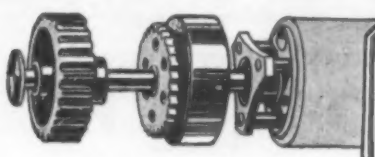

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Chemistry Notes

Out of the Way Scraps of Information in This Important Field

Synthetic Camphor.—Prof. Giraudet, of New Orleans, announces the discovery of a process for manufacturing synthetic camphor from turpentine. This, if practical, would break the Japanese monopoly.

An Unrecognized Danger.—The disaster at the Badische plant in Oppau was caused by the explosion of 4500 tons of a compound of ammonium sulfate and ammonium nitrate, heretofore considered absolutely safe from danger of explosion.

Home-Made Floor Oils.—One part boiled linseed oil thinned with three parts turpentine makes a good floor oil; while one part light, highly-refined engine oil combined with four parts kerosene gives results similar to commercial kinds.

A New Source of Asbestos.—In British Columbia, four miles north of Arrowhead, asbestos-bearing rock of considerable commercial value has been found. About 89 per cent of Canada's asbestos finds its way to the United States.

Glucinum.—This metal, melting at about 1300 degrees C., has hitherto been obtainable only in fine spangles very difficult to melt. German scientists are now able to prepare it in a compact form and pure state by an electrothermic method, details of which are not as yet available. The atomic weight of glucinum is found to be 9.017, or 1 per cent lower than indicated by earlier determinations.

An Air-Operated Hand Pick for miners is a German development; the pick has but one tine, the air enters at the end of the hollow handle, and the sharp point works its way percussively into the rock or coal. Our informant, the *Canadian Mining Journal*, adds that the tool has the formidable name of "Pressluftspitzhacke." In spaces too confined for the swinging pick it should offer distinct advantages.

Growth of the Gas Industry.—The steady growth of this industry is strikingly tabulated by "Brown's Dictionary of Gas Companies." Gas sales in 1902 were 92,714,667,000 cubic feet, and each succeeding year shows a substantial increase. In 1912 sales were 178,228,754,000 cubic feet; in 1918, 271,593,141,000 cubic feet; in 1919, 306,632,786,000 cubic feet; and in 1920, 319,887,813,000 cubic feet.

Furfural in the Corncob.—The corncob, that has hitherto had but a limited use for pipe bowls, is now found by the Department of Agriculture to contain about 10 per cent of high-grade furfural; this should give it an important place in the dyestuff industry and should still further undermine Germany's control of that industry. Further, a paste derived from the corncob may be used as a binder in the manufacture of fiber board and wall board.

A Big Piece of Coal.—The 12-ton block of cannel coal exhibited at the Chicago World's Fair in 1893 was probably the largest black diamond ever coaxed from the ground. It came from a colliery at Abram, England, where many men were employed for nine months in cutting it from the seam and raising it to the surface, at a cost of $400 a ton. This specimen of mining skill contained 350 cubic feet of coal, estimated to yield 182,944 cubic feet of gas.

British Gas Regulation Act.—This act permitted gas companies to declare the quality of gas they were best fitted to supply, and to substitute for the existing standard price for each hundred thousand British thermal units. By July 1, 1921, 57 companies had thus declared heat standard value ranging from 400 to 550 B.t.u. The average was 467 B.t.u., and 94 per cent of the 57 companies selected values between 450 and 500 B.t.u.

Mineral Products in 1920.—In both quantity and value our mineral-products sales showed improvement over the preceding year. The total value, $6,707,000,000, established a new record, but of course increased cost of operation contributed largely to this result. Depression marked the year 1919 down to autumn, whereas 1920 showed improved demand for the corresponding period, when it dropped into stagnation for the rest of the year.

Cheap Aid for the Confectioner.—A British inventor has secured a patent embracing the following: Kernels of cheap uncolored nuts, or cereals such as maize, are colored by immersion in a vegetable dye, dried in a hot chamber, and used for the decoration of confections, biscuits, etc., as a substitute for more expensive naturally colored kernels. Rectified alcohol sweet nut oil, or hot water may be used to dissolve the dye, and the dye may be allowed to penetrate into the kernels to any desired extent.

The Explosives Industry.—During 1920 27 manufacturers of explosives reported a marked recovery from the slump of 1919. Their domestic sales totaled 537,954,750 lbs., an increase of 29 per cent. Of these, 254,879,825 lbs. was black blasting powder; 229,112,084 lbs. was high explosives other than permissible explosives; and 53,962,841 lbs. was permissible explosives. The mining industry consumed 75.1 per cent of all explosives in 1920 as compared with 75.3 per cent in 1919; the greatest increase shown was in coal mining.

Petroleum in 1920.—A steady increase in production from January to November was succeeded by a decline, but the following March showed the largest monthly output on record. In 1920 all grades of petroleum quickly reached a maximum price; but early in 1921 a decrease in consumption and the doubling of imports combined to bring prices down on the run. Our methods of extraction are wasteful, and improved practice would materially prolong the life of the oil fields. As it is, our consumption is far in excess of production.

Basalt Handled Like Putty.—Dr. Ribbe of Auverne has at last succeeded in melting basalt and returning it to a condition more adamantine than before. This makes the rock available as a building and paving material of unexcelled quality, and as an insulator that dispenses with cement. We may now have brick and tile impervious to acids and more durable than ordinary stone. America is deeply interested, for if the process does what is claimed for it we can utilize the huge quantities of basalt now lying idle.

Sapphires from Montana. — Fergus county has a sapphire lode 5½ miles in extent, now being worked by nitro-explosive at a 250-foot level. For twenty years some of the finest sapphires in existence have been taken from these 1550 acres, the property yielding in that period $2,000,000 worth of the gems. A 4-carat stone brings from $30 to $300 per carat; a 1919 find weighed 10 carats, was cut down to 5 carats, and sold in London for $2000. The sapphire is outvying the ruby in popularity, and increased demand has resulted in the highest prices ever known.

Diamonds "Made in Germany."—A flood of synthetic gems, including diamonds, is said to be invading the German market. Since minute diamonds, laboratory-made at prohibitive cost, have long been an accomplished fact, it is not beyond possibility that some German scientist has solved the problem of producing carbon crystals of marketable size at reasonable cost. The value of the diamond is based on the barbaric in human nature; the same human nature decrees that what anybody can possess nobody wants; so that a success of this kind might relegate the diamond to the position of a Lazarus among gems.

Chemistry Taught by Cards.—An ingenious chemical set, the invention of a woman, comes to us from London. It consists of 58 cards of ascending sizes that are always whole multiples of the smallest size, each card representing one atom of an element, or one radical. Blue cards represent positive valencies, red ones negative. The class in chemistry can thus build up structural formulae in an interesting, easily-remembered way; the fundamental law that valencies must always be balanced is made plain, the behavior of a radical is readily grasped, and the connection between atomic weight, valency, and equivalent weight is obvious at a glance. The set forms a needed stepping-stone to the use of space models in organic chemistry.

Aeronautical Notes

Recent Activities and Forthcoming Plans That Mark the Progress of Mechanical Flight

French Gliding Competition.—Encouraged by the successes attained in the German soaring and gliding tests in the Rhön mountains last year, the French Aerial Association and the Aero Club of Auvergne are organizing a somewhat similar competition at Puy de Combegrasse, near Clermont Ferrand, Auvergne, between August 6 and August 20. According to *Flight*, a total amount of prizes of 100,000 francs is to be awarded. It is believed that British and other contestants, aside from French entries, will take part in the competition.

London-Brussels Service—A new aerial passenger line and fast freight service has recently been inaugurated between Croyden, which is the air port for London, and Brussels. Owing to the engineers' strike, delivery of new machines has been considerably delayed, but it is hoped that before long the Instone fleet, which has undertaken this service, will comprise ten passenger machines and two specially built cargo machines, when a regular and frequent service to and from Brussels will be run without in any way interfering with the London-Paris service.

Russo-German Air Mail Service.—Word comes to us that two Fokker monoplanes are to be used on the Konigsberg-Moscow service, which was inaugurated on May 1st. At first the service will be bi-weekly. Machines will leave Konigsberg on Sundays and Thursdays, and Moscow Sundays and Wednesdays. The railway journey between Berlin and Konigsberg occupies 12½ hours, and the flight between Konigsberg and Moscow 9 hours, giving a total of 22 hours, as compared with more than five days by train. The air mail fees are 8 marks for post cards and 8 marks for every 20 grammes in the case of letters.

Seaplane Floating Dock Tests.—From our British contemporary, *Flight*, we learn of the tests to which the Seaplane Floating Dock, built under arrangement with the Admiralty at Sheerness Dockyard, has been subjected before being handed over to the Air Ministry. The tests included towing trials and anchor trials, and the dock was also submerged, a seaplane being docked on the pontoon. The tests were satisfactory in every respect, and the dock was towed back to Sheerness yard to be completed for delivery. The dock is fitted for the reception of two seaplanes of the latest type.

Laminated Wood in Aircraft.—A necessary feature of all modern aircraft construction is the building up of the laminated wood parts. Most aircraft factories have a department devoted to this kind of work, with one or more batteries of special glue processes for joining the layers of wood into a compact whole. This careful lamination produces a unit infinitely stronger and more enduring than could possibly be shaped from a single piece of wood, while still preserving the important lightness and resiliency which are inherent to wood. The process calls for the most careful work, the best of materials, and ideal conditions in respect to temperature and humidity of the glue room. Science and experiment must be combined to secure an unfailing joint of maximum strength.

A New Gas for Airships.—From Los Angeles comes word to the effect that Dr. Edward Curran, head of the research department of a new aerial navigation company, has developed a new gas, Currenium, for airships. The new gas is said to be the outcome of several years of intensive study and experimentation. The company owning the formula is preparing to engage in the manufacture of the gas by an electrolytic process at a cost, it is estimated, of about $100.00 per thousand cubic feet less than it costs to produce helium. According to a witness of the demonstrations, the new gas has a lift about the same as pure hydrogen, but is non-inflammable and non-explosive. However, it remains to be seen whether the gas is all that is claimed for it, when it is once produced in commercial quantities.

Safety Fuel Tank Competition.—There have recently been held in England a series of tests with safety tanks of various kinds. On the first day the trials consisted of acceleration and crashing tests, and on the second day of firing tests. Twenty-six entries were received for the competition, which, it will be remembered, was being held in order to obtain, if possible, a tank which will withstand the shock to which it may be subjected in an airplane crash without either bursting or leaking, thus eliminating almost entirely the possibility of fire, and which will also withstand the effects of enemy action by machine gun and shell fire. The crashing tests are similar to those to which the tanks were subjected during the preliminary trials, in addition to special tests to determine the resistance to acceleration. In the firing tests the tanks were subjected to machine gun fire with ammunition capable of penetrating the ordinary type of mild steel fuel tank and of exploding and igniting the fuel either on contact or after penetration.

Recent Developments in Fighting 'Planes.—A G. A. X. armored attack triplane, which has excited much interest and comment among the members of the 3rd Group at Kelly Field, has been assigned to the 90th Squadron. This ship, a design of the Engineering Division at McCook Field and built by the Boeing Airplane Company of Seattle, is the first of several of these planes to be delivered for the use of the Attack Group. It is especially designed and constructed for the attacking of ground troops, states *Aviation*. In addition to being armored with machine guns, it carries a small cannon. The power plant consists of two Liberty engines set in a steel compartment, located in each wing. The weight of the ship empty (including water) is 7,532 pounds, and with crew, armament, and gas and oil, 9,750 pounds. The minimum speed at sea level is 63.8 miles per hour, and the maximum speed 105 miles per hour.

Night Landing Device.—The largest electric sign in the world is now operating at the Croydon air station, which is the air port for London. It is shaped like a star and has been constructed to assist belated pilots coming in to land on the airdrome during the winter months. The giant sign, measuring more than a quarter of a mile from point to point, is let into the ground, and over the whole of it has been fixed thick glass so that the surface is on an exact level with the surrounding ground, and an incoming air express can land with safety on and, if necessary, taxi across the surface of the guiding star. It is illuminated with several thousand electric lamps. An ingenious arrangement of the switching equipment enables the direction of the wind to be indicated to guide travelers on the airway. Every night during the winter a letter L of huge dimensions will be flashed to the skies, the position of same to be determined by the direction of the wind. The long leg of the L will show the airman in which direction the wind is blowing.

Certificates of Airworthiness.—At a recent meeting of the Executive Committee of the National Aircraft Underwriters' Association, states *Aviation*, it was determined that the present plan for registration of aircraft pilots and for registration of aircraft by Underwriters' Laboratories, be extended to include a plan for "certificates of airworthiness" for individual aircraft. It is the plan of the members of the National Aircraft Underwriters' Association to insist upon certificates of airworthiness as a condition of future policies on aircraft. This certificate is particularly essential and necessary at this time since it has been wrongly assumed that the registration of aircraft includes assurance of safety and airworthiness. This is not the case, as will be evidenced from a brief study of the International Aircraft Convention report. A certificate of registration is issued merely for identification purposes of individual aircraft, and offers no assurance whatever that the ship is safe to fly, or is capable of undertaking the particular work under consideration. Hence the airworthiness certificate program is essential to avoid misunderstandings covering the real significance of the Aircraft Register. In this connection all aircraft register certificates, going out after the first six, which have already been issued, will be rubber stamped diagonally across their face with outlined letters reading, "Airworthiness Certificate, none."

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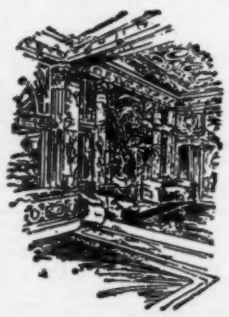

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(14403) P. C. writes: In a recent issue of the SCIENTIFIC AMERICAN a short paragraph appeared stating that during the next ten years astronomers would have only a few minutes while the sun was eclipsed in which to confirm the proof of Einstein's theory of the deflection of light waves by the attraction of gravitation. Instead of delaying for so long a time the decision of this matter by observations which might possibly be explained by refraction of the stellar rays in passing through the solar atmosphere, why not measure the deflection of light on the earth where errors caused by atmospheric refraction can be avoided? There can surely be no property possessed by the attraction of the sun which would not be displayed in a proportionate degree by the force of gravitation on the earth's surface.

Dr. Einstein states that he has proved theoretically that the rays of light from a star are deflected 1.7 seconds of arc while passing through the gravitational field of the sun. The sun's apparent diameter being about 32 minutes, it would therefore appear that the light is bent about 1/1129th part of the solar diameter, or that its total departure from a straight line is about 765 miles. An accurate calculation of the deflection of the rays per mile when the curve approaches most nearly to the surface of the sun would be of some difficulty, not only on account of the attraction continually increasing and decreasing as the beam drew near or departed from the sun, but also because the angle in which the gravitational pull acts on the ray is constantly changing from a right angle as it passes to practically nothing at extreme distances. An exact calculation, however, is entirely unnecessary for the purpose of my argument, and roughly I compute that if the above statement is correct the beam of light would be deflected when nearest to the sun at the rate of about three feet per mile. The attraction of gravitation on the surface of the sun is about 27.9 times the same force on the surface of the earth, so that a beam of light on the earth's surface should be pulled downward by gravitation somewhat more than one inch in a mile. So great a departure from a straight line is, of course, not possible, because precise levels, for instance, could not be run if the line of sight was so much deflected. My point, however, is that if the sun's attraction can cause the light from a star to bend, as asserted by Dr. Einstein, the earth's attraction would cause a beam of light to fall about 1/28th as much; and even if my calculation should be a hundred times too large, which I think is hardly possible, yet the deviation could be easily measured, and this would be simpler and more expeditious than to wait for solar eclipses extending over a period of ten years. A. P. C. has overlooked the more important of the two determining factors in this problem. The diameter of the sun is 866,000 miles, and we may conveniently define the sun's gravitational field, for the present purpose, as extending over this distance in the case of a light-ray that passes tangent to the disk. The corresponding distance for the earth is but 8000 miles. In both cases the gravitational field is at work during the entire time of passage of the ray. The time of passage for the earth's field, however, is but 8/866 that for the sun's field, since the speed of light is the same in both cases. The distance "fallen." by a ray of light, as by a more material object, varies as the square of the time

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during which the gravitational influence acts. The distance fallen by the ray of light that passes completely by the earth, then, if the earth's field were as intense as the sun's, would be $(8/886)^2$, or about 1/11500 of the corresponding distance in the case of the sun. As P. C. points out, however, the fields are not identical; that of the earth is but 1/28 that of the sun. This ratio must then be compounded with the other, since gravitational action is directly proportional to the field intensity; and we finally see that the ray passing completely by the earth will fall only 1/11500×1/28, or about 1/320000 as far as the ray passing the sun. As P. C. points out, in both cases we have made an error in failing to take account of the diminution of the force with increasing distance and decreasing angle. It will easily be seen that the force at a distance along the tangent equal to the radius will be approximately 1/3 that at the point of tangency, the distance now being $r\sqrt{2}$ in place of r, and the angle being 45° instead of 90°. When we compare the ray passing completely past the sun and the one passing completely past the earth the errors balance off to all intents and purposes and leave the ratio of the two forces the same. If we take the mean value of 2/3 as applicable throughout the distance traveled by the ray we shall be able to compare with the ray that travels a mere mile or two parallel with the earth's surface. Accepting P. C.'s calculation of 765 miles fall for the ray that passes the sun, the ray that passes the earth will fall 765/320000 miles, or about 13 feet. For comparison with the earthbound ray we reduce this by one-third, and it becomes about 100 inches. The ray that travels, say, two miles takes 2/8000 as long to do so as the ray that passes the earth completely; the square of this ratio is 1/16000000. The distance fallen in two miles will then be something like 100/16000000 inch, or 1/160000 inch. We can hardly hope to measure this deflection.

(14404) O. M. S. writes: Your answer to the question asked you September 22, "Will a ball of iron and a ball of cork, when let fall from the same height, fall to the ground at the same time?" does not coincide with the author of the Encyclopedia Britannica, ninth edition, Vol. XI, page 66, which maintains that two bodies when let fall at the same time from the same height will fall to the ground at the same time, except a feather, a balloon or a live bird. If the SCIENTIFIC AMERICAN is correct the encyclopedia is wrong and only good for the dumps. I would have good reason to doubt any one of the authors. A. We are not able to find your reference to the Encyclopedia Britannica since we have not the ninth edition. The eleventh edition of that valuable work was published in America in 1910, the ninth preceded it by quite a time and is now quite past. Nor was the statement as you quote it correct when the ninth edition was published. It is only in a *vacuum* that all bodies, light and heavy, fall with equal velocities, and hence through the same space in the same time. In a vacuum a feather falls with the same velocity as a bullet, as is shown in a well-known experiment. In the air they do not fall equally to the ground, as everyone knows. In the eleventh edition of the Encyclopedia Britannica, Vol. II, page 411a, is the statement, "Galileo taught that gravity and levity are relative terms—and that in a *vacuum* all bodies would fall with equal velocities." If any book contains any different statement from this we are not able to accept it, even if we are consigned to the "Dumps." There are many things besides the three you name which do not fall rapidly through the air, such as snowflakes, a sheet of paper and falling leaves, and you can supply many more.

(14405) T. F. H. asks: I understand it to be a fact that all whirlwinds, tornadoes, cyclones, typhoons (movements of air), and that all eddies, whirlpools, maelstroms, water leaving a washbowl, or bathtub (movements of water), unless artificially interfered with, revolve contra-clockwise. Is this true? If so, what causes this revolving always in that direction? A. The rotary motions which you describe are caused by the earth's rotation on its axis. They are counter-clockwise in the northern, and clockwise in the southern hemispheres. For the discussion of this subject we would refer you to Davis' Elementary Meteorology, page 101, etc. The full treatment, however, is mathematical.

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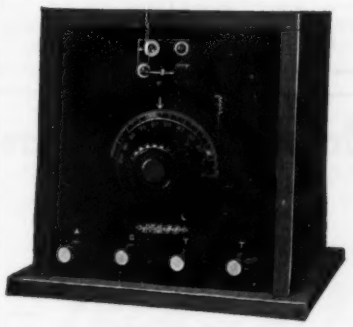

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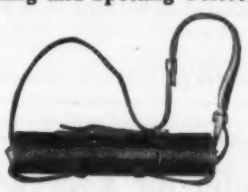

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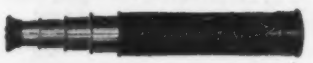

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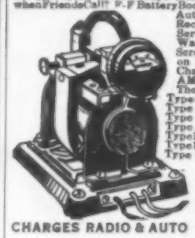

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LIMITED COMMERCIAL (BROADCASTING) STATIONS

So numerous have been the inquiries received with regard to a list of radio-phone broadcasting stations that we decided to publish a complete list of such stations, up to and including April 10th, which appeared in our June issue. As new stations are opened up for radio-phone broadcasting service, we shall endeavor to make mention of them in our future issues, thus keeping this list up to date. The present additional stations are From April 11th to May 17th.—THE EDITOR.

Call	Station
WBAY	American Teleg. & Telephone Co., New York.
WAAV	Athens Radio Co., Athens, O.
WSB	Atlanta Journal, Atlanta, Ga.
KQP	Blue Diamond Elec. Co., Hood River, Ore.
WBAE	Bradley Polytechnic Institute, Peoria, Ill.
KNN	Bullocks, Los Angeles, Calif.
WIZ	Cina Radio Mfg. Co., Cincinnati, O.
KUS	City Dye Works and Laundry Co., Los Angeles, Calif.
KUY	Coast Radio Co., El Monte, Calif.
WBAH	Dayton Co., The, Minneapolis, Minn.
KZN	Desert News, The, Salt Lake City, Utah.
WBAG	Diamond State Fibre Co., Bridgeport, Pa.
WAAG	Elliott Electric Co., Shreveport, La.
WBAV	Erner & Hopkins Co., Columbus, Ohio.
WRP	Federal Institute of Radio Telegraphy, Camden, N. J.
KTW	First Presbyterian Church, Seattle, Wash.
WAAS	Georgia Radio Co., Decatur, Ga.
WGM	Georgia Railway & Power Co. (Atlanta Constitution) Atlanta, Ga.
WAAK	Gimbel Bros., Milwaukee, Wis.
WAAR	Groves-Thornton Hardware Co., Huntington, W. Va.
KPO	Hale Bros., San Francisco, Calif.
KSC	Hale & Co., O. A., San Jose, Calif.
WBAQ	Harmon, Myron L., South Bend, Ind.
KXD	Herald Publishing Co., Modesto, Calif.
WAAZ	Hollister-Miller Motor Co., Emporia, Kans.
KON	Holzwasser, Inc., San Diego, Calif.
WHX	Iowa Radio Corp., Des Moines, Iowa.
WOI	Iowa State College, Ames, Iowa.
WSL	J & M Electric Co., Utica, N. Y.
KWH	Los Angeles Examiner, Los Angeles, Calif.
WBAW	Marietta College, Marietta, Ohio.
WBAJ	Marshall-Gerken Co., Toledo, Ohio.
WBAF	Middleton, Fred M., Moorestown, N. J.
WBAO	Millikin University, James, Decatur, Ill.
KOQ	Modesto Evening News, Modesto, Calif.
KGB	Mullins Elec. Co., Wm. A. Tacoma, Wash.
WAAQ	New England Motor Sales Co., Greenwich, Conn.
K&T	North Coast Products Co., Aberdeen, Wash.
WAAW	Omaha Grain Exchange, Omaha, Nebr.
WBAB	Potter, Andrew J., Syracuse, N. Y.
KZC	Public Market & Market Stores Co., Seattle, Wash.
WAAX	Radio Service Corp., Crafton, Pa.
WBAM	Rennyson, I. B., New Orleans, La.
WBAU	Republican Publishing Co., Hamilton, O.
WAAE	St. Louis Chamber of Commerce, St. Louis, Mo.
KNI	Smith, T. W.
WBAX	Stenger, Jr., John H., Wilkes Barre, Pa.
WBAD	Sterling Elec. Co. & Journal Printing Co., Minneapolis, Minn.
KOE	Spokane Chronicle, Spokane, Wash.
WAAP	Taylor, Otto W., Wichita, Kans.
KYF	Thearle Music Co., San Diego, Calif.
WBAZ	Times Dispatch Publishing Co., Richmond, Va.
WAAB	Times-Picayune, New Orleans, La.
WAAC	Tulane University, New Orleans, La.
WAAN	University of Missouri, Columbia, Mo.
KOJ	University of Nevada, Reno, Nev.
WWZ	Wanamaker, John, New York, N. Y.
WBAN	Wireless Phone Corp., Paterson, N. J.
WBAP	Wortham-Carter Publishing Co., Fort Worth, Texas.
WAAY	Yahrling-Rayner Piano Co., Youngstown, Ohio.
WCAZ	Compton, Robt. E. & Co., Quincy Whig Journal, Quincy, Ill.
KDYV	Cope & Cornwall Co., 1138 Michigan Ave., Salt Lake City, Utah.
WCAV	Dice Electric Co., J. C., 113 W. Capitol Ave., Little Rock, Ark.
WDAD	Harrison, William Louis, Central Kansas Radio Supply, 122 E. Lincoln St., Lindsborg, Kans.
KDYU	Herald Publishing Co., 119 Eighth St., Klamath Falls, Ore.
WDAI	Hughes Electrical Corp., 413 So. Clinton St., Syracuse, N. Y.
WDAC	Illinois Watch Co., 9th & E. Grand Ave., Springfield, Ill.
WDAF	Kansas City Star, 18th & Grand, Kansas City, Mo.
WCAY	Kesselman O'Driscoll Co., 517 Grand Ave., Milwaukee, Wis.
WDAG	Martin J. Lawrence, 605 East 4th St., Amarillo, Texas.
WDAH	Mine & Smelter Supply Co., 412 San Francisco St., El Paso, Tex.
WAAD	Ohio Mechanics Institute, Canal & Walnut St., Cincinnati, Ohio.
WCAW	Quincy Herald and Quincy Electric Supply Co., 1033 Maine St., Quincy, Ill.
KDYW	Smith-Hughes & Co., Phoenix, Ariz.
WDAB	Summer & Son, H. C., 906 Callia St., Portsmouth, Ohio.
WHB	Sweeney School Co., Sweeney Bldg., Kansas City, Mo.
WDAE	Tampa Daily Times, Tampa & Lack Sts., Tampa, Fla.
KDYS	Tribune, The, Inc., 113 4th St., N. Great Falls, Mont.
WCAX	University of Vermont, Burlington, Vt.
WDAA	Ward-Belmont School, Belmont Heights, Nashville, Tenn.
	Supplemental List—From May 1 to May 12, 1922, inc.
KDYL	Telegram Publishing Co., Salt Lake City, Utah.
KDYM	Savoy Theatre, San Diego, Calif.
KDYN	Great Western Radio Corp., Redwood City, Calif.
KDYO	Carlson & Simpson, San Diego, Calif.

(Continued on page 72)

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Interference Between Broadcasting Stations.—Broadcasting stations should shut off transmitters when not in actual operation to prevent unnecessary interference from carrier wave. Care should be taken not to extend schedules resulting in interference with the schedules of other stations. Transmitters must be adjusted so as not to produce unnecessary interference. It has come to the attention of the Department of Commerce that some stations have interfered over a band of from 200 to 500 meters, which may be reported as a violation of the law.

The Question of Echo.—Bare walls are not the best thing in the world for the radiophone broadcasting studio. Recently, one of the leading studios moved into a large, beautifully decorated room, with paneled walls and smooth, unbroken ceiling. Previous to that time, the studio held forth in what had been the cloakroom of a factory office, where the bare walls had to be hidden with draperies and rugs, while the ceiling was broken up by beams. However, the results obtained with the old studio room were excellent, for the reason that there was practically no echo or sound reflection from the walls and ceiling. The new studio room will have to be provided with tapestries or some other form of sound-absorbing hangings in order to reduce echo.

Radio Installations for Lightships.—According to George R. Putnam, Commissioner of Lighthouses, the radio telephone is shortly to make the life of the lighthouse keeper less lonesome and certainly more cheerful. The keepers of the Alaska lighthouses at the entrance to Behring Sea, for instance, remain at their posts for three years at a stretch, and some of them remain without mail for ten months at a stretch. With the cooperation of the Navy radio telephone equipment has recently been installed in several of the remote lighthouses in Alaska. Some of the lightships are also equipped as radio fog-signal stations. The radio installations are certain to maintain communication between the lightships and the outside world, and make life that much more endurable.

Doing Away with the Storage Battery would aid materially in the development of the vacuum tube receiving set and amplifier for home use. To this end numerous experimenters have endeavored to make use of the usual direct or alternating current lighting circuit, with anything from impossible to fair results. The hum of the lighting circuit must be eliminated if at all possible or at least brought down to a reasonable degree in order not to interfere with the intercepted radio-phone programs. The Bureau of Standards recently stated that it is now possible to operate a receiving set and amplifier on lighting current, but so far only meagre details are available. "The amplifier will utilize a 60-cycle current supply for both filaments and plates of the vacuum tubes," states the Bureau, "thus eliminating much of the interference met in an ordinary amplifier circuit. This interference has been practically eliminated by balancing resistances, grid condensers, and special grid leaks of comparatively low resistance, telephone transformer in the output circuit, and crystal detector, instead of vacuum tube detector. In the final form of the amplifier there is only a slight residual hum, which is not objectionable."

A German Radio-Phone Opinion.—From long and systematic experiments the German Post Office has come to the conclusion that radio telephony is the simplest and cheapest means of distributing news from a central point. The post office administration has entered into an agreement with a news distributing agency for the circulation of market prices of stocks, prices of material, and so on. Subscribers to the service pay 4000 marks per annum to the post office for installation and maintenance and a subscription for the news services to the press agency. Reception of news services which are not subscribed for is partially prevented by changing the figures, which have to be decoded by the subscribers entitled to the particular service. The apparatus consists of a single-wire antenna, loop antenna not being used since they involve expensive amplifying receivers. A single vacuum tube receiver is supplied, supplemented where necessary by two stages of audio-frequency amplification, while filament and plate currents are taken from the electric lighting circuit through suitable resistances. All apparatus is inclosed in sealed cases, inspection windows being provided so that the condition of the tubes may be readily ascertained.

Transmitting Aerials.—In the technical report of the Wireless Telegraphy Commission of Great Britain, with regard to the Imperial wireless system connecting Great Britain with the British colonies, there is an interesting section on transmitting aerials. The choice of an aerial for a new type of transmitter, states this section, lies between low aerials of great area and high aerials of smaller area. In the case of vacuum tube oscillators, where a plant large enough for the task is being made with difficulty, the high aerial of relatively small area is preferable. The preference is independently supported by a deeper study of the better wave-making properties of high as compared with low aerials. From the nature of the vacuum tube oscillator, it can be shown that a symmetrical aerial is more suitable than an unsymmetrical one, whether a low or a high aerial is concerned. The masts or towers used for supporting the aerial constitute the most costly item of a wireless station, and unless properly designed they affect and cause great loss of oscillatory energy generated. The ideal mast would be built of insulating material; wooden structures are an approximation to the ideal, but are unsuitable for the tropics. Steel structures are conductors, and cause considerable electrical loss. A great deal of this loss can be avoided by making the mast or tower in sections with insulating portions and standing the mast on an insulating base. There are some mechanical difficulties in this mode of construction, but they do not greatly affect the capital cost, and may be regarded as subsidiary detail. The above remarks apply alike to self-supporting towers and to masts supported by guys, the guys also being segmented by insulators in the latter case. The cost of masts is much less than of towers.

Localized Radio Landing Signals for Airplanes.—Radio direction finders and other radio devices have been in use for some time to assist airplanes to land during the night, during fog, or at other times of poor visibility. The usual method of using radio for this purpose is to transmit from an ordinary elevated antenna at the landing field, radio signals which are received on a direction finder located on the airplane. On small planes the direction finder may be simply a coil of wire wound on the fuselage; in large planes a small rotatable coil may be mounted vertically aft in the plane. This method gives the direction of the landing field, but does not give accurate information as to its distance when the plane is near the landing field. Now the Bureau of Standards has published a paper giving the theory of the radiation from an antenna consisting of two horizontal coils. It is found that if a vertical coil antenna is used for reception on the airplane and if the airplane flies horizontally, the maximum signal is received when the line joining the airplane to the transmitting coils makes an angle of 30 degrees with the vertical, assuming that the effect of the earth is negligible. The region of space within which the signal can be detected by receiving instruments of given sensibility has nearly the form of the space between two inverted coaxial vertical circular cones of finite length, having their common apex at the transmitting station. The upper limit of the region within which the signal is audible depends on the sensitivity of the receiving apparatus and is not as clearly defined as the bounding conical surfaces. The signal vanishes when the airplane is directly over the transmitting station, and vanishes rather soon after the airplane passes over the region of maximum signal and flies away from the transmitting station. By the proper application of these results it is believed that special transmitters can be built for landing stations which will send a localized landing signal for airplanes.

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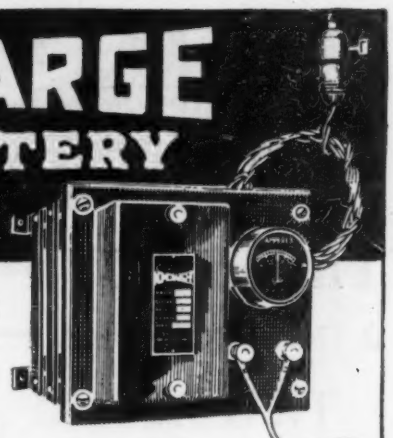

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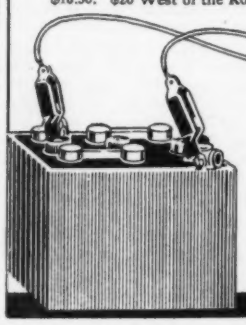

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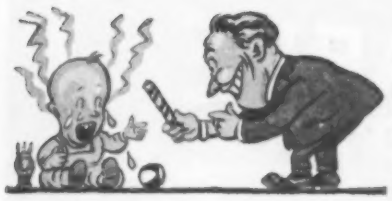

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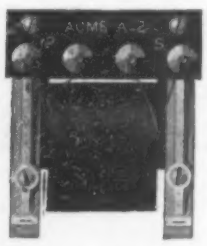

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Investigating Unknown Forces

(Continued from page 30)

magnetic phenomena are distinctly different from the "vital" magnetism on which magnetopathic treatment is said to be based, there is a striking connection between the two, for each time the subject has imparted such a treatment (with its obvious loss of vital energy), his ferro-magnetism is reduced in intensity.

Remarkable results have also been obtained in connection with *balance tests.* In one case there were recorded negative and positive changes in the weight of the person (medium) experimented on—reductions up to 25 kilograms and increases up to 10 kilograms, the normal weight being 60 kilograms. In addition to Grunewald and the medium, these *séances* were attended by a third person; a gentleman likewise endowed with mediumistic and "clairvoyant" faculties. Whenever the medium was undergoing any change in weight, this gentleman (without knowing anything thereof) would invariably state the appearance of some phantom-like materialization. Levitations of the medium balance were said to be produced simply by the phantom seizing the medium by his arms and lifting him. Whenever, on the other hand, the weight of the medium underwent an increase, the "clairvoyant" gentleman would announce that the medium was being pressed down or that the phantom-like formation was mounting on the balance. While these assertions, being merely subjective, must be taken at their face-value, the fact that they not only account in a plausible manner for those changes in weight objectively recorded, but with absolute accuracy coincide with balance records, is, to say the least, highly remarkable. In one case the "medium" was placed on one of the balances and the "clairvoyant" gentleman on the other (generally used as "phantom" balance). A striking connection between the deflections of the two balances was then noted, the two deflections always being equal (though of opposite directions) and occurring at the same moment. Flashlight photographs in cases such as these supplement visual observation and weighing records.

A remarkable series of tests has just been concluded at Copenhagen. Though the experiments of Schrenck-Notzing, Geley and others, to say nothing of earlier experimenters, by the evidence not only of the senses, but of photographic plate, already afforded practically absolute proof of the reality of materialization phenomena, some super-sceptical critics still would find fault with the conditions under which these experiments had been made. Grunewald, therefore, in connection with his recent work on Ejner Nielsen, further sharpened the conditions of control by not only submitting the medium before each *séance* to a thorough medical examination, but sewing the man (perfectly stripped beforehand) into tights and inclosing him in a cage with muslin walls through which the phenomena of materialization could be watched. In spite of such rigorous conditions positive results were obtained, of which a detailed account is shortly to be published in the continental press.

The Statistics of Climate

(Continued from page 21)

dispose of in a given time. Their capacity should not exceed this amount beyond a reasonable margin of safety; otherwise cost of construction would be unnecessarily great.

This list of examples might be extended almost indefinitely. It will suffice, however, to show how wide a range of climatic information is required to meet all possible demands. The different branches of science, art and industry are concerned with different sets of climatic data. One set helps determine the best location for a railroad; another the kind of goods that will be shipped over it and the way in which they will need to be packed and cared for during shipment. The climatic conditions that must be considered in planning a military campaign are quite unlike those that engage the attention of a hydrological engineer in laying out a system of irrigation. Climatic statistics of interest to aviators are not identical with those that bear upon the problems of ecology or forestry or sanitation. In short, climate means very different things to different people.

Even if all parts of the earth's surface were amply provided with meteorological stations at which observations had been maintained for many years, it would be a colossal task to prepare climatic statistics for the globe comparable in fullness to the existing statistics of population, natural resources, agriculture, commerce, and various other things. The magnitude of the task is not, however, the only reason why it has been so imperfectly carried out. In spite of the efforts of certain international conferences, there is a conspicuous lack of uniformity in the methods of climatographers as practiced in different parts of the world. Important data easily obtainable for one region are wholly lacking for others. For instance, one would seek in vain to gather statistics of snowfall for all the important cities of the temperate zones. Diversity in the use of technical terms leads to constant misunderstandings on the part of those who consult climatic tables for the different countries. Thanks to these discrepancies, added to differences in conventional methods of tabulation, a multiplicity of languages, and a variety of units, it is probably no exaggeration to say that there are not a dozen persons in the United States who are well qualified for the supposedly simple task of extracting from the published data the statistics of climate that are daily needed for one purpose or another.

Lastly, the literature of climatography is very poorly represented in the average scientific or general library, and is therefore at the disposal of but few inquirers. In this country the only approximately complete collection of such literature is that in the Weather Bureau Library, at Washington.

As to handy digests of the more important climatic statistics for the world at large, the one and only work of this character is Hann's "Handbuch der Klimatologie," no complete translation of which has ever been made into English or any other language. A good-sized encyclopaedia of climate is one of the greatest outstanding needs in scientific literature.

The Business of Broadcasting

(Continued from page 9)

mechanism, enclosed in a sealed case, which could be used at the receiving end. Then, at the expiration of the subscription term, the wave-changing mechanism would have to be returned to the subscription office and a new sealed case procured upon the payment for the new subscription term.

The only technical difficulty in the way of this scheme is that of absolute synchronization. It stands to reason that unless the wave-changing devices at the transmitting and the receiving end are in perfect step, queer results will be obtained. Again, there are many ingenious persons who could possibly construct a wave-changing device and obtain the service without subscribing, but this would call for such a degree of ingenuity that only a small proportion of the radio-phone audience would be able to "get in free," so to speak.

In telephony various so-called voice distorting systems have been worked out. Indeed, in connection with the radio link—a radio-phone span introduced in a regular wire telephone system—some form of voice distorting device is almost certain to be used in the near future in order to insure privacy. The same idea might be applied to paid broadcasting, although the mechanism is apt to be considerably more complicated than would be permissible for such an application. For the time being, various radio men whom the writer has interrogated along these general lines are of the opinion that the simplest method is to form a radio association and issue licenses and certain distinctive labels or seals to its members. It is estimated that each member would have to set aside only a very small per cent of his annual turnover as a contribution to a broadcasting fund. Then, by a cleverly handled publicity campaign, the public could be impressed with the fact that all apparatus bearing the seal of the association had contributed its quota towards the broadcasting expenses. Of course, such a plan would not prevent anyone from listening in with any apparatus whatsoever, but the American sense of fair play would certainly compel a buyer to purchase licensed equipment in preference to unlicensed equipment, if price and quality were the same.

Then again, it has been suggested that the Government could tax all radio receiving sets a very small annual fee, and use the moneys received from this source for the operation of high-grade broadcasting stations, which could well afford to pay for the leading musicians and lecturers of the Nation and of the world. However, whether this comes within the province of the Government or not is a much mooted question. Another suggestion is that certain philanthropical gentlemen

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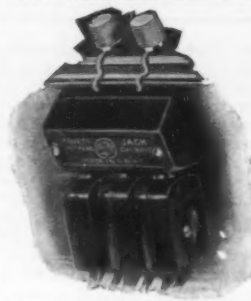

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might well divert some of their donations from the present normal courses to a broadcasting foundation, in order that moneys would be available for free broadcasting services of the highest order.

At any rate, some method must be worked out in the near future in order to defray the heavy expenses of high-grade broadcasting, especially when it becomes necessary to pay for the talent. Meanwhile, other broadcasting services which furnish news, talks, phonographic music and so on, are bound to increase in numbers, so that the radio-phone receiving set must have more and more features to select from as time goes on. Broadcasting is here to stay: it is indispensable: someone will always be ready to undertake gratuitous broadcasting.

The Psychic Detective

(Continued from page 7)

mented with this medium, produced a book illustrated with the scripts of fifty or more purported spirits. In this book he declared that these scripts in many instances were recognized by him as having the characteristics of the actual life writing of his relatives and friends whom the communicant spirits claimed to be. If this similarity existed, it could be tested by well-known methods; and the investigator, having made handwriting one of his studies for many years, requested the privilege of carrying out such tests. Properly enough, the lawyer required a demonstration of the investigator's ability in this line of work; and one of the tests proposed and accepted was a proof, in detail, that the lawyer himself had not written the scripts. The lawyer's writing and the spirit messages were given a two hours' examination and the results put before the lawyer. On the lawyer's own admission, more knowledge was adduced of the peculiarities of his writing than he himself had gained in forty years. Other tests were met with equal satisfaction; the lawyer was satisfied with the investigator's ability to proceed, and furnished all necessary material.

Since this particular medium is so outstanding a figure, it was thought worth while to make the investigation an exhaustive one. Briefly summarized, these are the results:

(1). In no case did the spirit script correspond with the life script of the purported writer, and in every case multiplied reasons were given for this judgment.

(2). Common characteristics were found to run through the entire series of "spirit" scripts, and this assertion was not only made but amply demonstrated, so that any tyro could easily test it for himself. One part of this test was to use a random set of one hundred life scripts and to ascertain the percentages by which the several characteristics appeared in this series of actually different scripts.

(3). With some difficulty, samples of the medium's own writing were procured and the same characteristics were demonstrated to be found therein. On the basis of the percentages according to which six selected characteristics of the "spirit" scripts were found in the letters of the hundred group, it was demonstrated that a finding of simply these six peculiarities in the medium's own writing had less than one chance in 200,000 of happening by mere coincidence.

In addition, certain other tests were employed, such as the finding of mannerisms of speech running through the purported spirit writings to a degree far beyond what could happen by chance. Also a peculiar tendency on the part of the spirits, with different sitters, to draw forget-me-nots. And the finding, upon slates sent to the American Society for Psychical Research, of four almost identical infantile drawings representing two men engaged in fisticuffs, one a tall man with traces of a beard and wearing a tall hat, the other a short man with traces of long hair whose derby hat had fallen from his head. These drawings were made by different "spirits," for different sitters, at different dates ranging eleven years apart. All this seems to imply that the four artists belonged to one family if they did not reside under one hat.

An eminent lecturer, who has been telling us about the work of William Hope, the English spirit-photographer, is reported to have complained that the (English) S. P. R. does not investigate him. Yet he knows the S. P. R. has tried to do so and he must know the difficulties which have been put in its way. The lecturer is himself on record as saying in print, "Consider the case of spirit photography. I entirely sympathize with the mediums in their refusal to submit their results to men who have continually shown an unfair and insulting attitude toward them." And the unfair and insulting attitude consists in the desire to have experiments under test conditions and in making true remarks about the pictures. The American investigator committed the blasphemy of printing in the Journal of the A. S. P. R. some queer facts which he discovered regarding quotations from foreign languages found on some of the photographic plates. The most of these quotations were stock phrases easy to find in printed lists. One set apparently had been copied out in alphabetical order. One phrase (*ob mort-es nostr-orum fratr-um*) had been hyphenated, just as it is hyphenated in elementary Latin text-books to exhibit the case- and tense-endings. Is it insult to point out that this is just what a photographer, profoundly ignorant of Latin and working from such a text, might do? This investigator would probably be denied sittings because of the offense of calling attention to unwelcome facts.

But in spite of frauds culpable, the automatic impostures of hysteria, and self-deception and blunders of inference, there remains a wide field worthy of investigation. If all the spurious phenomena of mercenary professional mediums and others were annihilated, the brushwood would be swept away from the real problems, which all the skill and experience gained have not explained by normal causes. Of course we can hypothesize a telepathy which works by relays all over the world, peeps into books and whispers to the embryo all that ever happened since Adam. We can suppose a Cosmic Reservoir where the thoughts of all the ages are slopping about and where the psychic can draw up exactly such fish as she needs. Or that the vibrations of all thoughts ever thought in a building are in its walls ready to impinge on a sensitive brain and convey information. Or that Deity is operating a great wireless station expressly in order to supply data. All these hypotheses, however, are speculations flying loose, without the standing room of any ascertained facts, and simply testify to the ingenuity of imagination. And granting that any of them is true, it simply lets us fall from the frying-pan into the fire of the supernormal.

The Antigonish Ghost

FOR the benefit of readers who were unable to follow the course of this "spook" through the newspapers of early March, we give here the essential features of the case. For some time mysterious fires had been occurring in the farm-house of Alexander MacDonald, in Caledonia Mills, Antigonish County, Nova Scotia. These were for the most part in the wall-paper; as many as 38 occurred in a single night. Cattle were turned loose and occasionally killed; horses' tails were braided in their stalls; articles were moved about in the house; in fact, the antics of the traditional poltergeist were followed closely.

Several attempts at investigation were abortive. In one instance, a detective and a reporter were mysteriously slapped as they slept in the house, and heard footsteps above them. Mrs. MacDonald finally underwent a nervous collapse and the family, consisting of herself, her husband, and an adopted daughter in her 'teens, Mary Ellen, vacated the house. No further damage occurring in their absence, Mrs. MacDonald became convinced that the house was haunted; and that having driven the humans away, the spirits were content.

The A. S. P. R. became interested in the case and Dr. Prince undertook an investigation. He went to Caledonia Mills and spent a week in the house. In the absence of the family nothing occurred; they were moved back into the house and still nothing occurred. Dr. Prince was accordingly reduced to a critical study of the premises, the traces of old fires, and the old testimony. The most significant bits of direct evidence were the finding of a burnt match in a little used transom above which one of the old fires had occurred; and the turning up of the "ghost's" supply of a very material liquid fuel, kept in an equally prosaic glass bottle.

On the basis of previous cases of the same sort—which are plentiful—it was to be altogether expected that the "spirits" would thus refuse to perform in the presence of a competent observer. It was equally to be presumed that Mary Ellen would turn out to be a hysteric of some sort, and to have played the tricks while in a state of more or less altered consciousness. No evidence was found indicating that she could not have done everything that had been done; much was found indicating that she could. Dr. Prince accordingly reported that she was the

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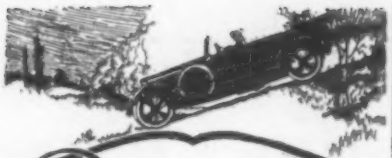

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"ghost," but that she was not necessarily in any way culpable for what she had done. The negative character of the finding, since Mary Ellen was not actually caught in the act, cannot be disputed; but at the same time it must be remembered that a finding of this character was all that could have been anticipated. Caution rather than bravado is characteristic of the hysteric who does poltergeist tricks; and the only hope of catching one in the act is by keeping secret the investigator's presence.

Extreme interest in the case was taken all over the country. Great numbers of communications were received from apparently hard-headed citizens suggesting electric disturbances, vagrant radio currents, etc., as the source of the disturbances. Dr. Prince, it is to be emphasized, found no evidence whatever of this; and it would indeed be an extraordinary radio wave that would untie knots, open stalls, braid the horses' manes and tails, and move bed-cushions up and down stairs.

Policing the Radio Highways and Byways

RADIO is unique in many ways, but in no other way is it so unique as in the fact that its followers insist on having laws and Government regulation to the utmost. The reason is simple enough: without laws and Government regulation, radio would become a free-for-all fight in the ether, with the most powerful transmitter predominating in its immediate vicinity, and with long-distance work and uninterrupted reception a sheer impossibility. Of course, there is such a thing as too much Government regulation. In certain countries the radio amateur is required to secure a license for a receiving set as well as a transmitter, and the laws are so severe that amateur radio has made little, if any, progress. But our American laws and Government regulation pertaining to radio have been fair in the extreme, and under them amateur radio has thrived to the wonderment of the entire world, and radiophone broadcasting has attained a vogue that is a revelation to everyone.

Laws and regulation must be formulated to maintain the ether or radio highways and byways in the most efficient condition for the great majority of radio amateur novices, commercial companies, and Government stations. The ether is not a limitless medium so far as our present radio practice is concerned, and it is even now quite evident that with the ever-increasing number of radiophone and radio telegraph stations in operation, stringent rules must be followed in order to reduce interference to a minimum.

How are the laws enforced? Why does a person have to bother with a license for transmitting? Cannot the transmitting equipment be purchased and clandestinely installed and operated? These questions are often asked by persons not intimately familiar with the way of things in radio.

Under the present system any piece of radio equipment can be purchased without formality. It can be installed without formality. But when it comes to operating a transmitter, a license must be obtained in short order or the operator soon faces the Government authorities on the charge of violating certain laws of the land.

Just how the unlicensed transmitter is run down to earth is a far simpler matter than is apparent to the laity. In the first place, the present system of transmitting licenses makes it necessary for every transmitter to use a "call"—a combination of numerals and letters not unlike the automobile license, and serving virtually the same end. Therefore, since these "calls" are published in various forms and are in the possession of all amateurs, any unknown "call" or duplicated "call" immediately becomes the subject of much suspicion. Secondly, the dyed-in-the-wool radio amateur is critically attentive to radio activities at all times. Nothing escapes him in his broad vicinity. Any infraction of the radio laws, such as transmitting on a wave length beyond the allotted amateur range, he soon reports to the radio inspector of his district. Finally, the radio inspectors, with the aid of amateurs, can soon locate the unlicensed transmitter within a small territory, and by a little detective work the station is finally discovered and visited.

There is no such thing as hiding the radio transmitter indefinitely. Even if the aerial is inclosed in a chimney or strung in an attic, the offending transmitter can be found. If necessary, the radio inspector and his staff can use the radio compass principle, as shown in our cover illustration. The radio compass consists simply of a wooden frame that holds a number of turns of wire, these turns serving both as the antenna and ground connections for a receiving set. The loop, as this arrangement is called, is a directional affair. It receives best when pointing end on toward the transmitting station. By getting directional bearings on the clandestine transmitter at two different points and laying out the directional lines on a map, it becomes possible to discover the exact location of the transmitting station, which is the point where the lines cross. During the war the radio compass was employed for locating hidden radio transmitters, but in normal times such an arrangement is rarely employed. The mere fact that it is available should be sufficient to prevent transmitters from operating without licenses.

As a whole, the radio amateur and radio novice are a most law-abiding folk, and a letter from the radio inspector, informing them that they are violating a law or regulation, is generally sufficient to correct violations. Again, the radio inspectors are at all times ensured the watchful services of amateurs and novices in their respective territories, thus simplifying a task that would be well nigh impossible with the limited personnel now available for the radio inspection service.

LIMITED COMMERCIAL (BROADCASTING) STATIONS

(Continued from page 68)

KDYQ	Oregon Institute of Technology, Portland, Ore.
KDYR	Pasadena Star-News Publishing Co., Pasadena, Calif.
KLX	Tribune Publishing Co., Oakland, Calif.
KNX	Electric Lighting Supply Co., Los Angeles, Calif.
KQI	University of California, Berkeley, Calif.
KYI	Alfred Harrell, Bakersfield, Calif.
KZV	Wenatchee Battery & Motor Co., Wenatchee, Wash.
WAAD	Ohio Mechanics Institute, Cincinnati, Ohio.
WCAB	Newburgh, News Printing and Publishing Co., Newburgh, N. Y.
WCAC	John Fink Jewelry Co., Fort Smith, Ark.
WCAD	St. Lawrence University, Canton, Ohio.
WCAE	Kaufman & Baer Co., Pittsburgh, Pa.
WCAG	Daily States Publishing Co., New Orleans, La.
WCAJ	Nebraska Wesleyan University, University Place, Nebr.
WCAK	Alfred P. Daniel, Houston, Tex.
WCAL	St. Olaf College, Northfield, Minn.
WCAM	Villanova College, Villanova, Pa.
WCAN	Southeastern Radio Telephone Co., Jacksonville, Fla.
WCAC	Sanders & Stayman Co., Baltimore, Md.
WCAP	Central Radio Service, Decatur, Ill.
WCAQ	Tri-State Radio Manufacturing & Supply Co., Defiance, Ohio.
WCAR	Alamo Radio Electric Co., San Antonio, Texas.
WCAS	William Hood Dunwoody Industrial Institute, Minneapolis, Minn.
WCAT	South Dakota State School of Mines, Rapid City, South Dakota.
WCAU	Philadelphia Radiophone Co., Philadelphia, Pa.
WCX	Detroit Free Press, Detroit, Mich.
WHB	Sweeney School Co., Kansas City, Mo.

Distinguishing Characteristics of Mahogany

ONLY true mahogany from tropical America, "African mahogany," and "Philippine mahogany" are commonly sold as mahogany in this country, but at various times over 60 different species of timber have been sold under that name. Although all of these species resemble each other in varying degrees, tropical American mahogany and "African mahogany" possess one important characteristic in common. This is the occurrence of dark amber-colored gum in many of the pores. The gum does not fill the pores but is recognized as dark specks or streaks in the pores as seen on end or side grain. This gum is barely visible to the naked eye, but is easily seen through a hand lens with a magnification of 10-15 diameters. In preparing the end grain of the wood for examination, a very sharp knife should be used to make a smooth cut.

Some other woods have similar dark masses of gum in the pores, but none of these are commonly substituted for mahogany. Among them are crabwood and sapeli, species imported from South America in small quantities only, and the Cedrelas (Spanish cedar, etc.), which are rarely sold as mahoganies, and are easily recognized by their odor.

True mahogany has fine, continuous, concentric lines on the cross section usually from ⅛ to ½ inch apart, which distinguish it from "African mahogany" in which these lines never occur.

"Philippine mahogany," although not marked by the black masses of gum, is distinguished from true mahogany and other so-called mahoganies by the presence of fine, white, tangential lines ⅛ inch to several inches apart, readily visible to the naked eye, and showing under a lens as rows of small openings filled with white substance.

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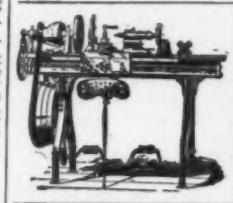

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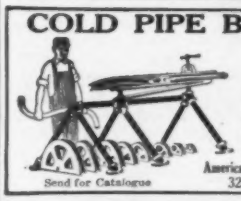

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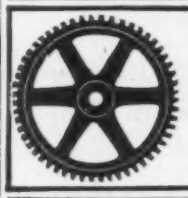

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2. Probable Course of Bond Prices in 1922
3. Franklin Simon's Foresight Built Great Business
4. Wanted: A Rediscount Policy for Federal Reserve Banks
5. Preparing College Men for Work

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2. How to Reduce Manufacturing Costs
3. Practical Tips for Advertisers
4. A Plan That Keeps Your Head Clear During Readjustment
5. Can Executive Be Picked by Mental Tests?

February 4th
1. Our Neglected "Foreign Market" in U. S. A.
2. How Will Copper Industry Fare?
3. The Good in Trade Associations
4. Making a "Safety First" Record
5. Buying for Seven Billion Dollar Trade

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1. Forbes Refuses to Join Pessimistic Chorus Now Coming from Bankers
2. How to Cash in on Advertising
3. Why Foreign Currency Inflation Hurts Us
4. Have You a Little Wireless in Your Home?
5. Business and the Stock Exchange

March 4th
1. The Worst Brake on Business Relaxes
2. Who Pays for Wasteful Price-Wars?
3. Will Business in 1922 Parallel 1818?
4. Why Canada Pays Premium for U. S. Funds
5. Mexico—Economic Eldorado

March 18th
1. How James H. McGraw Serves Business Men
2. Civility Enters Public Service
3. Outlook for Wages—Up or Down?
4. Labor Challenges Court Decision
5. Which Rails to Buy

April 1st
1. How Ward Became "Tip Top" Baker
2. How's Your Human Inventory?
3. Is Political Unrest Growing?
4. The Man Who Audited the A. E. F.
5. Getting Sick Men Back to Work

April 15th
1. The Causes of Business Failures
2. Will House Rents Come Down?
3. Anthracite Reeks With Graft
4. Which Business Books Have Helped Me Most?
5. Where Our Goods Are Needed

April 29th
1. B. C. Forbes' Interview with Herbert Hoover
2. How Young Men Built National Business in Small Town
3. Life-Size Trade Marks Capture Trade
4. Are Coal Workers Overpaid
5. The Omnibus Versus Street Car

May 13th
1. The Story Behind 187 Stores
2. Loan Shark Still Flourishes
3. Prospects of Dividend Resumption Brighten Outlook of Ten Preferred Stocks
4. Building Business Is Booming
5. Super-Power Will Aid Industry

May 27th
1. Are Spectacular Events Likely?
2. Right Organization Essential, Says Thomas E. Wilson
3. How Colors Put New Life and "Pull" Into Letters
4. Which Business Books Have Helped Me Most
5. What Cheap Money May Mean for Railroad Stocks

June 10th
1. How Rogers Peet & Co. Built Huge Retail Business
2. Trend of Trade Association Activities
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